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THE CHEMIST.

ORIGINAL COMMUNICATIONS.

ACTION of SULPHURETTED HYDROGEN on SALTS of ZINC and COPPER.

By PROFESSOR F. CRACE CALVERT.

READ BEFORE THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

IN all our treatises of analytical chemistry it is stated, that the process to be followed to separate zinc or its compounds from those of copper, is to render the liquids acid which contains salts of these metals, and to pass a current of sulphuretted hydrogen, when the copper will be precipitated in the state of sulphuret, leaving the zinc in solution.

Having had lately to analyse several alloys of zinc and copper in connexion with some researches on alloys, I found it impossible to make two analyses of the same alloy correspond satisfactorily. To ascertain the cause of error I made several trials, and soon found out that zinc, even in very acid liquors, was freely, and sometimes completely, precipitated from them by sulphuretted hydrogen. I also remarked, that the facility with which zinc was precipitated from an acid solution depended, in a great measure, on the peculiar salt of zinc which was used in solution, and the nature of the acid employed to acidify the liquor. The results contained in this paper are so conclusive on this point, that the old method (which is still recommended in recently published works on quantitative analysis) for the separation of salts of zinc from those of copper, must in future be rejected as completely inexact.

My experiments were made by employing 18 grains of crystallised and pure sulphate of zinc, dissolving them in 400 grains of distilled water, and adding to the liquor equivalent quantities of an acid, for example, as there existed in the quantity of sulphate of zinc used for the experiment (18 grs.), 5 grains of sulphuric acid; 2.5, 5, 10, 12.5, or 15 grs. of sulphuric acid were added, after being previously mixed with such a proportion of water as to give in each jar of an experiment 1,500 grs. of fluid. The time required for a precipitate to appear was carefully noted down, and also the time which elapsed before the liquors were filtered off. The filtrates were then tested to ascertain if any salt of zinc remained in solution; the results obtained are given in the Tables.

TABLE, No. 1.

No.	$\text{SO}_3 \text{ ZnO} + 7 \text{ HO.}$	$\text{SO}_3.$	Water, Total quantity 1500 grs.	Time when precipitate appeared.	Time of passing H ₂ S through the liquor.	
1	18 grs. containing 5 grs. of SO_3 in 400 grs. water	2.5 grs. (half the quantity of SO_3 of the sulphate in 50 grs. water)	1050 grs.	The precipitate appeared in all cases in the space of from 3 to 10 min., probably, after saturation of liquor with H ₂ S. Rapidity of current has influence.	4 hours	Precipitation complete.
2	18 grs. in 400 grs. water	5 grs. in 100 grs. water	1000 grs.		4 ditto	Precipitation complete.
3	18 grs. in 400 grs. water	7.5 grs. in 150 grs. water	950 grs.		4 ditto	Precipitation complete. A trace of zinc not precipitated.
4	18 grs. in 400 grs. water	10 grs. in 200 grs. water	900 grs.		6 ditto	The greatest part of the zinc precipitated.
5	18 grs. in 400 grs. water	12.5 grs. in 250 grs. water	850 grs.		6 ditto	
6	18 grs. in 400 grs. water	15 grs. in 300 grs. water, or 3 equivalents	800 grs.		6 ditto	

I also made another series of experiments, in which I employed weaker solutions, viz., diluting with twice their bulk of water similar solutions to those obtained in the above table, and these are the results obtained :—

TABLE, No. 2.

No.	$\text{SO}_3 \text{ ZnO} + 7 \text{ HO.}$	$\text{SO}_3.$	Water, Total quantity 4500 grs.	Time when precipitate appeared.	Time of passing H ₂ S through the liquor.	
4a	18 grs. in 500 grs. water	10 grs. in 100 grs. water	3900 grs.	After a few minutes	5 hours	All precipitated.
5a	18 grs. in 500 grs. water	12.5 grs. in 125 grs. water	3875 grs.	ditto	ditto	Almost all precipitated, but after 12 hours standing complete.
6a	18 grs. in 500 grs. water	15.0 grs. in 150 grs. water	3850 grs.	ditto	ditto	P. not complete even after 12 hours standing, the quantity not pp. was considerable.

It will be observed, in perusing the above tables, that zinc is freely and generally completely precipitated from its combination with sulphuric acid, even in liquors containing a great excess of sulphuric acid, or from three to four times as much free sulphuric acid as existed in the quantity of salt used.

I also thought it advisable to make a series of experiments, employing chloride of zinc, and adding to it submultiple or multiple quantities of hydrochloric acid, and these are the results obtained.

The required amounts of acid were calculated by employing a quantity of acid containing a given proportion of chlorine.

TABLE, No. 3.

No.	Zn Cl.	H Cl.	Water.	Time when precipitate appeared.	Time of passing H ₂ S through the liquor.	
1	10 grs. containing 5·26 of chlorine, or 5·33 hydrochloric acid in 250 grs. water	2·63 grs. half the quantity of the Cl of the chloride in 125 grs. of water	1125 grs.	3 minutes	5 hours	{ A considerable quantity of zinc precipitated, but not complete. Only partially precipitated. Small quantity precipitated. Precipitate not complete. Almost all precipitated. A trace not precipitated. All precipitated.
2	10 grs. in 250 grs. water	5·26 grs. in 250 grs. water	1000 grs.	5 ditto	ditto	
3	10 grs. in 250 grs. water	7·89 grs. in 375 grs. water	875 grs.	8 ditto	ditto	
4	10 grs. in 250 grs. water	1·32 grs. in 250 grs. water	1000 grs.	3 ditto	ditto	
5	10 grs. in 250 grs. water	0·66 grs. in 125 grs. water	1125 grs.	3 ditto	ditto	
6	10 grs. in 250 grs. water	0·33 grs. in 62 grs. water	1188 grs.	2 ditto	ditto	
7	10 grs. in 100 grs. water	0·165 in 250 grs. water	1150 grs.	2 ditto	ditto	
INFLUENCE OF DILUTION WITH WATER.						
4a	10 grs. in 110 grs. water	1·32 grs. in 250 grs. water	4140 grs.	3 ditto	ditto	{ Precipitate complete without leaving it to stand for a longer time. Precipitate complete.
4aa	10 grs. in 110 grs. water	1·32 grs. in 250 grs. water	7140 grs.	3 ditto	ditto	

In comparing the results contained in this table with those of the previous ones, it will be noticed that zinc is more easily precipitated from its combination with chlorine, and in presence of an excess of hydrochloric acid, than when it is combined with sulphuric acid. Still, in either case, and even in presence of a very large excess of acid, zinc is precipitated, and, in many cases, completely.

Before undertaking a series of experiments to discover a new method of separating quantitatively zinc and copper, I thought it advisable to examine the various processes which have been proposed of late years, and these are my results.

I first made a series of experiments with a process which has been recommended by Messrs. Rivot and Bouquet, and which consists in adding an excess of ammonia to an acid liquor containing the above two metals, and then adding caustic potash in slight excess. The liquor is to be heated to 158° F., until the whole of the ammonia is expelled, the copper being thrown down in the state of black oxide, whilst the oxide of zinc remains in solution; but I have always found, even in employing diluted liquors and a very slight excess of potash, that always a certain proportion of hydrate of oxide of zinc, dissolved in the caustic potash, was dehydrated, became insoluble and precipitated with the oxide of copper, thereby increasing its relative proportion, and rendering the results incorrect.

The two above methods having failed in my hands, although I had taken all the necessary precautions recommended to carry out those processes successfully, I next had recourse to the methods proposed by M. Flajolot. The first consists in adding to a boiling solution of zinc and copper, rendered slightly acid by sulphuric acid, hyposulphide of soda until no more black sulphuret of copper precipitates, filtering and determining the copper by oxidising the sulphuret with nitric acid in the usual way, and throwing down the copper. The zinc is precipitated with carbonate of soda. The second process given by this chemist consists in estimating the copper by precipitating it in the state of proto-iodide by a solution of iodine in sulphurous acid.*

Both these processes by M. Flajolot gave very satisfactory results, and can be adopted when a complete analysis of an alloy of zinc and copper is required; but as these methods require too much time when rapid analyses are desired, I next tried M. Pelouze's method, which consists in rendering the liquor containing salts of zinc and copper alkaline, with an excess of ammonia, and pouring very gradually into it a standard solution of mono-sulphuret of sodium, which first precipitates all the copper as black sulphuret, leaving the zinc in solution. As this latter metal yields a white sulphuret, it is easy to ascertain when all the copper is precipitated.

This method is so easily and rapidly performed that I thought it advisable to test its accuracy, and the following results leave

* For further details, see CHEMIST, first volume, page 641.

no doubt as to its exactitude and value. The zinc is determined by difference.

	Taken.	Obtained.
Copper	1.16	1.17
Zinc	17.97	17.96
Copper	9.91	9.935
Zinc	3.55	3.525

On the ELECTRO-CHEMICAL DEPOSITION of METALS.

By ALEXANDER WATT.

(Continued from page 709, vol. II.)

ELECTRO-DEPOSITION OF SILVER (*continued*).

BRITANNIA metal, pewter, and all combinations of lead and tin, are best plated in a weak solution containing a good deal of free cyanide. Deposition should be suffered to take place slowly at first, gradually augmenting the speed of the operation as the coating becomes thicker. Unless the operation be carried on thus cautiously the articles will strip.

I generally find that, by adding to the ordinary solution about 500 per cent. of water and a little free cyanide, it will work very well with this class of goods. In plating the above metals a larger surface of anode must be exposed than would be required for brass or German silver work—probably three times the surface.

The battery power employed must be energetic, but not too intense. Two cells of the constant battery recommended will give sufficient power for objects of considerable size.

Articles made of Britannia metal, &c., should not be allowed to be disturbed while in the solution. They may be shifted now and then in order to expose a different surface to the anode for the sake of securing uniformity, but it is not advisable to let the solution be agitated more than is absolutely necessary. This caution, however, is chiefly applicable to the period when the articles are first immersed in the bath. The goods may be prepared for plating, by being brushed over with silver sand and water, with a moderately hard brush, instead of the powdered bath-brick used for other metals. The articles should be cleansed from grease by immersion in the hot caustic alkali bath.

If the goods, when they have been placed in the plating bath for a few moments, assume an unequal surface, it is advisable to remove them, and have them brushed over again as before; then, after well rinsing them, they may be returned to the bath, and allowed to remain without further interruption until sufficiently coated.

The readiest mode of coating articles of lead, Britannia metal, zinc, or tin, is to previously cover them with a film of brass in the brassing bath, or with copper in the alkaline coppering bath. Either brass or copper (in small quantity) will adhere very firmly to the surface of

these metals, and the silver may be deposited upon the coppered or brassed surface with perfect facility and certainty of success. After the articles have been removed from the brass or copper bath, they may be well scratch-brushed, rinsed, and immediately immersed in the plating bath.

When an article has been plated, and is found to strip or blister in many places, it may be necessary to remove all the silver from its surface and plate it again. There are two kinds of *blistering*; the first is the non-adherence of the silver to the article coated; and the second, the blistering or *doubling* of the metal of which the article is composed. When the blistering is of the first kind, the article, after the silver has been removed from it by the process described below, may be rendered smooth with emery cloth and water-of-Ayr stone previous to being replated; but if the metal itself has blistered when the burnisher was applied to it, the blisters must be scraped, buffed, or filed down, and the surface be rendered smooth in the ordinary way.

The silver is removed (or "stripped") from the articles thus:—Put some strong sulphuric acid into a stone jar or enamelled saucepan, and add a little nitrate of potassa. Apply heat until the nitrate is dissolved. When very hot the articles are to be immersed in the liquid, and occasionally moved, until all the silver is removed. The removal of the silver will become manifest by the metal being exposed at the edges of the article, when the operation must be closely watched, in order to prevent the articles remaining longer in the solution than is necessary. If it is found that the above solution acts tardily, a little more nitrate of potassa may be added from time to time, and the heat increased if required.

When a quantity of things have been stripped in the solution, it will work very slowly, and a mass of crystals will be found at the bottom of the vessel as it cools. It is advisable now to add a quantity of cold water to the solution, and to immerse in it several pieces of zinc, which will throw down all the silver in the metallic state, but in small crystals. A few drops of hydrochloric acid added to the solution will show whether all the silver is thrown down or otherwise, as the acid forms a white precipitate if silver is still present in the liquid. When all the silver is precipitated, the supernatant liquor may be poured off carefully, and fresh water added to wash the precipitate, which process may be repeated several times in order to render the silver as clear as possible. The silver may now be dried, and put into a crucible (being previously mixed with a little dry powdered potash), and heated until the metal is gathered into a button. The silver thus obtained will be perfectly fine.

The silver may be precipitated from the stripping solution by common salt, when a chloride of silver will be formed, which may be dried and fused in the same manner as the above, previously mixing a little soda or potassa to form a flux.

Or the article to be stripped may be made to answer the purpose of a positive electrode or anode, by which means the silver to be removed

may be transferred to some other article, or may be deposited on the end of a piece of silver wire, enclosed in a linen bag, in the form of crystals of silver, which may be collected and melted.

Deposition of Silver on Non-Metallic Substances.—Silver may be deposited in the same way as copper by the electrotype process, but as cyanide of potassium rapidly dissolves wax, it will not be advisable to make moulds of that material—gutta percha is better; but even this substance is acted upon by cyanide of potassium. Moulds made of fusible metal or copper (by the electrotype process) are best for the electro-deposition of silver in the cyanide of silver baths. When copper moulds are used for this purpose, the copper may be dissolved from the silver coating by very hot dilute hydrochloric acid, which will dissolve the copper without acting upon the silver. Or dissolve some crystals of sulphate of iron in boiling water, add a little nitrate of potassa, precipitate the iron with carbonate of soda, and wash the precipitate several times. Dissolve the oxide of iron thus formed with hydrochloric acid. Immerse the article in this solution, when the copper will be readily attacked. When the above solution ceases to have any action on the copper, precipitate the iron with soda or ammonia, pour off the solution of copper, to which add a few pieces of iron to precipitate the copper. Dissolve the precipitate of iron with hydrochloric acid, and it will be again ready for use. The silver article may now be heated to cherry-redness and allowed to cool, when it may be dipped into a pickle made with very dilute sulphuric acid, which will cause it to assume a dead white surface.

The solution for depositing silver upon non-metallic surfaces, or upon copper for the purpose of obtaining solid articles, should be much stronger than for other purposes, that is to say, it should contain about seven or eight ounces of silver to the gallon.

A solution of nitrate of silver is also suitable to the purpose of depositing silver upon plumbagoed surfaces, but care must be taken not to have the solution too strong, or the deposit will be granular; but this solution must not be used for depositing silver upon copper.

The backs of copper moulds to be coated with silver, should be covered with some material to prevent the silver being deposited on their surface, for which purpose it has been recommended to boil a little pitch in a strong solution of potassa, which will form a sediment. Some of this sediment is added to a quantity of melted pitch, at which time a violent action will take place, and white fumes will be evolved. Allow this action to subside, and the material will be ready for use. Melted gutta percha will also answer tolerably well for cementing the backs of metallic moulds.

There are many other practical points in the electro-deposition of silver to be considered, which we will give hereafter in an appendix to these papers, and which we deem it advisable to defer, in order that we may at once proceed to the electro-deposition of other metals, that the reader may have at once a general outline of the principles of electro-depositions of all the metals. We now proceed to the

ELECTRO-DEPOSITION OF GOLD.

In importance, electro-gilding is second only to the art of electro-plating, and it is carried on in much the same way as that art. The solutions of gold, however, should be generally worked hot; hence the operation is conducted in a much shorter space of time than is required for electro-plating. An article may be well and strongly coated in a few minutes, whilst it would require several hours to electro-plate an article well.

There are many forms of solution in use amongst electro-metallurgists, all of them varying in the proportion of gold per gallon, and in the proportion of solvent employed. These solutions are all of them easily made, and almost all of them can be worked well by a skilful operator. Some gilders use five or six pennyweights of gold to the quart of solution, others as much as eight or ten dwts.; but I have generally found that a solution containing less gold will give better results than one richer in metal. I have observed that a solution containing five or six dwts. of gold to the quart of solution, and the necessary quantity of cyanide, worked with several united Smee's cells, has required at least ten times the surface of anode to be exposed to a given surface of negative electrode (that is, article to be gilt) than would be required to gild an article in a solution containing one and a half dwts. to the quart of solution, worked with a single cell of my battery. Hence I infer that the weaker solution is the better conductor of the two.

Gold Solutions.—Solution I.—Dissolve, in a Florence flask, one pennyweight and a half of fine gold in two parts hydrochloric acid and one part nitric acid (*aqua regia*), applying a gentle heat to accelerate the chemical action. When the gold is all dissolved, pour the chloride of gold formed into a porcelain capsule, and apply sufficient heat to evaporate the acid, when a rich red mass will be formed. It is advisable, when the acid is nearly all expelled, to move the capsule round and round, so that the liquid remaining may be well dispersed over the vessel. It will be found that the liquid will cease to run when all the acid is expelled, at which period the operation is complete. Next add about half a pint of cold distilled water, which will readily dissolve the chloride of gold. Allow this to subside for a few moments, as in all probability there will be a small amount of white precipitate at the bottom of the capsule, which is chloride of silver; the solution of gold must be carefully poured off from this, as it will injure the solution if it be allowed to enter it. A little distilled water may be now put into the capsule to rinse away all the gold, taking care, as before, not to allow the sediment to come away with it, when transferring the liquid to the solution of gold.

A little strong solution of cyanide of potassium is now added, gradually, to the solution of gold, until it produces no further action on the liquid, which will lose its yellow color. A brown precipitate is thus formed, which must be allowed to subside, when the supernatant liquor is to be poured off carefully, and fresh water added several times

to wash the precipitate. A sufficient quantity of the solution of cyanide is now added to dissolve the precipitate, or rather more. The concentrated solution of cyanide of gold thus obtained is placed on the fire until it is nearly evaporated to dryness, when it may be again dissolved and filtered when cold. Enough boiling distilled water is now added to make one quart of solution, and a little additional cyanide may be added from time to time to make the solution work with the required speed, but it is advisable not to add more cyanide at first than will do the work tolerably quickly, otherwise the solution will not gild a good color, and the anode will become rapidly consumed.

Solution II.—Dissolve one and a half dwt. fine gold as before, and evaporate to dryness; redissolve in half pint of distilled water, and precipitate the gold with ammonia, taking care not to add more ammonia than is necessary. Pour off the supernatant liquor, and wash the precipitate as before. Now add sufficient cyanide of potassium to dissolve the precipitate. Evaporate nearly to dryness, and redissolve with a little cold distilled water. The solution is then to be filtered, and distilled water added to make one quart. A little solution of cyanide is to be added occasionally as required.

Solution III.—Dissolve one and a half dwt. fine gold as before, and when the solution of chloride of gold is obtained, but before it is evaporated, add a quantity of calcined magnesia, which will precipitate the gold in the form of an oxide. To the oxide add sufficient concentrated nitric acid (applying heat at the same time), to dissolve the magnesia, when the oxide will be left in the form of a precipitate, which is to be well washed, and a solution of cyanide of potassium added to dissolve it. Evaporate as before, and then make one quart of solution with boiling distilled water.

Solution IV.—Dissolve one ounce of cyanide of potassium in one quart of nearly boiling distilled water. About half fill a small porous cell with the solution, and stand it in the larger quantity of solution. Attach a piece of sheet copper to the wire issuing from the zinc of the battery, and place it in the porous cell; put a piece of sheet gold, attached to the copper of the battery, in the outer solution, and allow the whole to remain in action until the solution has acquired about one pennyweight and a half of gold, when the porous cell may be removed, and its contents thrown away. The solution is now ready for use.

These solutions should be worked at a temperature of about 130° F., with one cell of the constant battery described in a previous article.

London, Sept. 15, 1855.

(To be continued.)

CHEMICAL TABLES. COMPILED BY THORNTON J. HERAPATH.

No. IV.—Table showing the Behavior of Substances with Reagents, and for Testing by the Blowpipe:—Proximate Organic Analysis.

Distinctive Reactions are printed in *italics*. Precipitants used in quantitative analysis are distinguished by an *.

B'.—INORGANIC SUBSTANCES:—ACIDS.

CLASS III.—NON-METALLIC ACIDS, OR ACIDS WHICH ARE NEITHER PRECIPITATED BY SULPHURETTED HYDROGEN NOR BY HYDROSULPHATE OF AMMONIA.

Sub-Class I.—Acids which are precipitated from their Neutral Solutions by Nitrates of Baryta.

** Barytic precipitate soluble in boiling Hydrochloric Acid without effervescence.

(Continued from p. 713, Vol. II.)

Acids.	Color of the precipitated sulphide.	Action of Special Tests, and Behavior before the Blowpipe.
Bromic acid		<i>Bromates are decomp. by heat, leaving a residue of bromide (vide Hydrobromic acid); and also by acids, evolving bromine, which will dissolve gold.</i>
Boracic acid		Borates are decomp. by acid, and boracic acid is liberated, which crystal. from hot solu. in <i>nacreous scales</i> , and affects <i>turmeric paper in the manner of a free alkali</i> . Boracic acid is sol. in alcohol, and tinges the blowpipe-flame <i>green</i> . <i>B. B.—Borates, when mixed with powdered fluor-spar and a little bisulphate of potash or oil of vitriol, and heated on charcoal, communicate a beautiful green tinge to the flame.</i>
Hydrofluoric acid		<i>Fluorides, when mixed with oil of vitriol, corrode glass, and when distilled with vitriol and silica, yield a gas (3-fluoride of silicon) which is decomp. by water, with the produc. of a gelat. ppt. of silica.*</i>
Silicic acid		<i>B. B.—Vide Boracic acid.</i> <i>When a silicate is decomp. by acids, and the solu. is evap. to dryness, the silicic acid is left as a white pulver. residue insol. in water and acids.*</i> <i>Vide also Hydrofluoric acid.</i> <i>B. B.—When a silicate is fused with microcos. salt on a platinum wire, the silicic acid is left insol. floating about in the fluid glass.</i>
Oxalic acid		<i>Oxalates are decomp. by vitriol, evolving carbonic acid and carbonic oxide. Alkaline and earthy oxalates are decomp. by heat, leaving a residue of carbonate (vide Carbonic acid).</i> <i>Oxalic acid crystal. in long acicular crys., which strongly depolarise light; and when heated with chloride of gold, it yields a ppt. of metallic gold.</i>

Acids.	Color of the precipitated Sulphide.	Action of Special Tests, and Behavior before the Blowpipe.
Phosphorous acid		<i>Nitrate of silver,* brown ppt. of metallic silver. Sulphurous acid converts it into phosphoric acid, evolving sulphuretted hyd., with a ppt. of sulphur.</i>
Phosphoric acid		<i>Nitrate silver,* yellow. Ammonia-acetate of magnesia,* white crystal. ppt., sol. in acetic acid. Peracetate of iron,* yellowish-white, changing to yellowish-brown on addition of an ex.; insol. in acetic acid.</i> [Pyro- and meta-phosphoric acids, and their salts, yield white ppts. with <i>nit. silver</i> . Metaphos. acid precip. albumen from white of egg, on the addition of acetic acid; pyrophos. acid does not.]
Selenious acid } Selenic acid }		<i>Vide B'.—Class I.</i>
*** <i>Barytic precipitate insoluble in Hydrochloric Acid.</i>		
Sulphuric acid		<i>Nitrates of lead* and barytes,* white heavy ppts., insol. in nitric acid. Nit. of silver, crystal, ppt. in concn. solu.</i> <i>B. B.—Sulphates when mixed with charcoal powder and a little caustic lime, and heated in R. F. are reduced to sulphides (vide Hydrosulphuric acid).</i>
Sub-Class II.—Acids which are not precipitated from their Neutral Solutions by Nitrate of Barytes.		
* <i>Acids which are precipitated both by Nitrate of Lead* and Nitrate of Silver.*</i>		
Hydrosulphuric acid		<i>Nitrates of silver and lead, black. Most sulphides are decomposed by boiling hydrochloric acid. Hydrosulphuric acid gas possesses a nauseous odor, resembling that of rotten cabbage, and produces a brown or black coloration with silver or lead paper. Its behavior with metallic solutions is shown under the head A'. Neutral solu. of the sol. sulphides, communicate a magnificent purple coloration to solutions of the alkaline nitroprussides.</i> <i>B. B.—Insol. metallic sulphides when heated in O. F., give off sulphurous acid gas. All sulphides are decomp. when fused with carbonate of soda in a porce. capsule; and the fused mass when moistened with water, and placed on a silver coin or on lead paper, produces a brownish-black stain thereon.</i>
Hydroselenic acid		<i>Nitrates of silver and lead, dark colored. Sol. selenides yield a red ppt. when treated with sulphite of ammonia and strong sulphuric acid.</i>

Acids.	Color of the precipitated Sulphide.	Action of Special Tests, and Behavior before the Blowpipe.
Hydroselenic acid		<i>B. B.</i> —Selenides, when heated in O. F., give off the characteristic odor of selenium compounds. When volatilized in a closed tube, selenium yields a steel-grey slightly metallic deposit, which appears violet or blue when in thin layers.
Hydrophosphorous acid		Nitrate of silver, brown ppt. of Ag. <i>B. B.</i> —Hypophosphites, when heated to redness in a tube-retort, evolve spontaneously inflammable phosphuretted hydrogen.
Hydriodic acid		Nitrate silver,* light yellow (detects 1-50,000 of iodine) nearly insol. in nitric acid and in ammonia. Nitrate lead, fine yellow. Chloride of mercury, beautiful scarlet, very sol. in excess. Chlor. palladium,* deep brown. Dilute nitric acid and starch, fine blue (detects about 1-500,000). When mixed with chlorine-water, and agitated with chloroform, it yields a fine violet solu.
		<i>B. B.</i> —Iodides, when heated in a tube with a little vitriol and peroxide of manganese, evolve iodine as a beautiful violet vapor. With microcos. salt and oxide of copper, in O. F., they color the flame fine green.
Hydrobromic acid		Nit. silver,* very pale yel., turned white by hydrochl. acid. Nit. lead, white, sol. in nitric acid. Dilute nitric acid and starch, fine yel. or orange-yel. Heated with hydrochl. acid and a little bleaching powder (chloride lime) it evolves free bromine, which is sol. in ether, with a red or orange red color.
		<i>B. B.</i> —Bromides when heated in a tube with bisulphate of potash, evolve bromine as a yellow vapor. With oxide of copper, &c., they behave like the iodides.
Hyposulphurous acid		Nit. silver, white ppt. becoming black. Nit. lead, white, sp. sol. in nitric acid. Sulphuric acid resolves it into sulphurous acid and sulphur. The alkaline hypsulphites readily dissolve chloride and cyanide of silver.
Hydrochloric acid		Nitrate of silver,* white curdy ppt. insol. in nitric acid, but readily sol. in ammonia, hypsulphite of soda and cyanide of potassium. Nitrate lead, white ppt., somewhat sol. in boiling water, and crys. on cooling in shining spangles. Soluble chlorides when mixed with nitric acid and heated, will dissolve gold; and, when mixed with sulphuric acid and peroxide of manganese, evolve chlorine gas, which bleaches litmus paper, &c.

Acids.	Color of the precipitated Sulphide.	Action of Special Tests, and Behavior before the Blowpipe.
Hydrochloric acid		<i>B. B.</i> —Chlorides, when mixed with microcosmic salt and a little oxide of copper, communicate a fine greenish-blue color to the O. F.
Hydrocyanic acid		Cyanides, when heated in a tube or watch-glass with dilute sulphuric or hydrochloric acid, give off hydrocyanic acid, which has an odor like that of oil of bitter almonds. Prussic acid yields a white pulverit. ppt. with nitrate of silver,* which is sol. in hot nitric acid; with a mixture of potash and sulphate of iron, it occasions the formation of Prussian blue, which is insol. in hydrochloric acid; and when mixed with bisulphide of ammonium, and the mixture is evap. to dryness, the fixed residue on being acted upon by water, yields a solu. which produces a blood-red coloration with per-salts of iron (sulphocyanide).
** Acids which are precipitated by Nitrate of Silver, but not by Nitrate of Lead.		
Hydrosulphocyanic acid		The salts are precipitated by nit. lead in concn. solu. Nit. silver,* white and curdy, sol. in strong liq. ammonia. Sulphate cop., black. Per-salts of iron, blood-red solu., the color of which is destroyed by solu. of chloride of mercury, proto-chl. of tin, &c.
Nitrous acid (hyponitrous acid)		Nit. silver, white, sp. sol. in water. Sol. nitrites give a yellow ppt. with nitrate or chloride of cobalt;* and are decomp. by heat and by sulphuric acid, evolving red fumes, which decolorises a solu. of cochineal. When mixed with hydrochloric acid, nitrites do not act upon gold.
*** Acids which are neither precipitated by Nitrate of Lead, nor by Nitrate of Silver.		
Nitric acid		Dry nitrates when heated in a tube with bisulphate of potash, give off red fumes of hyponitric acid. When heated with dilute sulphc. acid, and a small crystal of sulphate of iron (copperas) is dropped into the solu., a deep-brown coloration is developed. Free nitric acid decolorises a solu. of sulphate of indigo; and when mixed with hydrochloric acid dissolves gold. <i>B. B.</i> —Alkaline nitrates, on platinum foil, fuse, evolve oxygen, and are converted into nitrites. On charcoal, the nitrates cause deflagration.
Chloric acid		Chlorates, when treated with sulphuric or hydrochloric acid, give off a yellow or greenish-yel. explosive gas. Potash gives no ppt. with chloric acid.

NOTES on ANALYSIS *by* MEASURE.—By MR. ROBT. WEST PEARSON.

ESTIMATION OF BARYTA IN THE SOLUTIONS OF THE ALKALINE EARTHS.

It is well known to chemists that the chromates of potash produce precipitates in solutions of the alkaline earths of bichromate of baryta without in the slightest degree affecting the salts of strontia or lime.

This test is exceedingly delicate, occurring in solutions containing less than the thousandth part of a grain of baryta.

In applying this fact to analysis by measure, the difficulty appears to be to mark the exact point at which the whole of the baryta present is precipitated. This I believe I have overcome by the use of a solution of litmus in water, litmus being readily oxidised by oxydising agents; *i.e.*, nitric acid, chromic acid, &c. The color of the solution changing from a blue to a dark green with chromate of potash, and to a yellow with bichromate of potash. This change is especially produced in warm solutions. It is necessary to ascertain if any nitric acid exists in the solution to be tested for baryta, by a preliminary experiment. If so, it is necessary to add acetate of soda or acetic acid, sufficient to replace the nitric acid in solution.

Previous to adding the solution of litmus to the fluid containing baryta, &c., the solution should be heated to ebullition to expel any carbonic acid or free oxygen that might be present with the water.

The principles of the process now described, then, are:—1st. That chromates of potash produce precipitates in solutions of barytic salts generally. 2nd. That by adding a solution of litmus, so as to color the solution slightly blue, I obtain an indicator as to how far the precipitation advances, on slowly adding chromate of potash. 3rd. That by the use of solutions of chromate of potash of a known strength, I can calculate the amount of chromate of potash used, and, *vice versa*, the amount of baryta precipitated as chromate of baryta. The preparation of materials is simple; I take several grains of dry and pure chromate or bichromate of potash, and dissolve in distilled water, so as to obtain a solution containing 1 in 100 parts of liquid. In the same way I prepare solutions containing 1 in 1,000 grains, and also a solution containing 1 in 10,000 grains of water. I then prepare a strong tincture of litmus by dissolving in water, the exact strength of which it is not necessary to know. All these solutions should be perfectly clear. They can be kept any length of time in stoppered bottles; the litmus I prefer in “capped” bottles, with a drop tube in it.

The Process.—Measure off 1,000 grains of the solution to be tested (which has already been subjected to the preliminary tests noticed above), and, if necessary, acetic acid added; pour into a flask of twice the capacity; heat to boiling, and add one or two drops of litmus solution. Maintain at a temperature near 212° F., and slowly add the standard solution of chromate B., which contains 1 grain in 1,000 of water, from a graduated burette, chromate of baryta will continue to precipitate during the experiment. By thus adding

small quantities of chromate solution, the blue color will entirely disappear, giving rise to a dark green color easily to be distinguished, and which pervades the whole mixture. After the last addition, allow it to settle for about five minutes, add a drop of chromate solution, and, if it gives a precipitate, add cautiously from the standard solution C. (1 in 10,000 grains) till all the baryta is separated. Until no change occurs, count the figures on the burette, and ascertain the amount of chromate of potash solution required to saturate the baryta.

The estimation is now complete, and by simple application we can know the amount of baryta as chromate present, and from it the baryta; 100 grains of solution B. corresponds to 1-10th grain chromate baryta.

The method I have just described is simple and accurate, neat, and requires no great manipulation. These qualities recommend it. It may be applied to the analysis of other substances; for instance, chromium, in which I intend to substitute a reaction of pyrogallic acid; nitric acid, hitherto a somewhat difficult acid to estimate. In the next number of THE CHEMIST I shall give an account of some of these methods, and also some examples to show the value of the chromate of potash process for baryta described above.

Dr. R. A. Smith's Laboratory, Manchester.

On a NEW PROCESS for DECOLORISING SYRUPY and other SOLUTIONS.

By MR. R. WEST PEARSON, Manchester.

It has long been considered a great desideratum to obtain an abundant, cheap, and safe substitute for animal charcoal, at present so largely employed in the refining of sugar. Charcoal has long been known to possess the property of absorbing certain gases with great energy, and it has consequently been used as a disinfecting agent. This power it possesses in a remarkable degree, but it varies for different gases, thus, for instance, recently ignited wood charcoal absorbs—

90	times its own volume of ammonia.
85	“ “ hydrochloric acid.
55	“ “ sulphuretted hydrogen.
35	“ “ carbonic acid.
9	“ “ oxygen.

The gases therefore are not only absorbed, but also condensed with very great force. This absorbing power of charcoal is mechanical, and is attended with no chemical action, for the gases may be expelled by heat unchanged. Equally remarkable, though even more obscure in its theory, is the property which charcoal possesses, of absorbing the coloring matter of vegetable substances. This property was first discovered by Lowitz, of St. Petersburg, and since carefully studied

by MM. Payen and Bussy. This property is not confined to any one kind of charcoal, and varies in intensity with the porosity or state of mechanical division. The objections to the use of charcoal in refining on a large scale is the expense, and the necessity of frequent renewal. This occurs from the fact, that the charcoal retains the inorganic impurities, as iron, &c., in the raw material, and which in a short time color the solution, which color increases the longer it is used; no process that I am aware of, completely removes this impurity on the large scale. The process I have to describe, which is quite distinct from charcoal, although it has been necessary to allude to it, is as follows:—

It consists in the use of a solution of sulphate of alumina, which, on being added to the syrup, immediately precipitates or coagulates the coloring matter in solution, and on boiling readily deposits it. There remains an amount of free sulphuric acid in solution, which I completely remove by the cautious addition of milk of lime. On decanting the solution after this addition of lime, it possesses a yellow tinge, such as syrups invariably possess before crystallising. If the process has been well executed, no iron whatever will remain in solution.

I have no doubt that the cases are numerous, in which this process can be employed in the most efficacious manner, in preventing the formation of those colorings, which, when once formed it is found so difficult to remove, and I believe it to be worthy of the attention of persons employed in many branches of the productive arts.

As examples of the use of alumina I may mention, that having procured specimens of water, literally full of peaty matter, held in solution, and giving to the water a dark brown color, I added to a portion of this sample a small quantity of well washed alumina, agitated, and in about an hour the alumina subsided, carrying with it the whole of the coloring matter, for the water was absolutely colorless. I tried the hardness of this water; before decolorising it I took 6·5 measures of Clarke's soap test, after addition of alumina, 7·6 measures; there was consequently a very slight addition of inorganic matter, though this, I believe, might be dispensed with. I also tried sewage with alumina, and obtained satisfactory results; several well-known chemists, among others, Professor Way, however, do not approve of alumina for sewage purposes.

TRANSLATIONS AND ABSTRACTS.

CHEMICAL PHILOSOPHY.

ANIMAL PHOSPHORESCENCE.

T. HERAPATH, the eminent chemist, has read a paper before the British Chemical Society, combatting the view that animal phosphorescence is owing to the slow combustion of phosphorus. He has made experiments with glowworms in glass vessels, and whilst emitting light, no ozone was produced. He ascribes the phenomenon of light in glowworms to carbon in some allotropic condition, not yet understood. This bears on a question at issue between Liebig and Mulder, as to whether phosphorus occurs in the animal tissues, merely as phosphoric acid (?) or phosphamide. It is our opinion that Herapath is right; the light of the fire-fly is not due to phosphorus, we think, for we do not know of a single case where it has been demonstrated by a careful experiment.

Scientific American.

On the BODIES whose DECOMPOSITION takes place under the INFLUENCE of what is termed CATALYTIC FORCE. By MM. THENARD.

It is well known that the discovery of oxygenated water or binoxide of hydrogen dates from the year 1818, and that this singular compound possesses such singular properties, that it has become the type of a new branch of chemistry. When put in contact with many bodies, even at the ordinary temperature, for instance, with one of the least oxidisable metals in the form of powder, it decomposes suddenly, sometimes with explosion, disengages half the oxygen which it contains, and is transformed into water without the metal absorbing the least quantity of the torrent of gas in the nascent state, in the midst of which it had been placed.

It was very important to investigate all the analogous phenomena, to ascertain what bodies would produce them, and to appreciate the circumstances in which they were produced. We undertook a work of this nature some years ago, and we now submit it to the judgement of the Academy.

We shall now only show in a general manner, the means which we have used and the results which we have attained; on a future occasion we shall describe the apparatus which we used, and in a final memoir, we shall show all the facts which we have observed, and explain the frequent experiments which we have tried on the various bodies which have been the objects of our numerous investigations.

The problem which we have endeavored to solve is this:—A body being given which, with heat, disengages a gas or can disengage one, theoretically speaking, to seek what bodies by mixing with it, would have the property of facilitating the disengagement of the gas, without absorbing the smallest portion of it, without undergoing the least alteration, in fact, acting in the same manner as the least oxidisable metals on binoxide of hydrogen.

To solve this problem completely and as easily as possible, it is

necessary, after procuring the bodies in the greatest possible state of purity, to satisfy the following conditions :—

1. To take the exact weight of the body from which the gas is to be disengaged; the operation is usually made on quantities varying from one and a half grammes to four grammes.

2. To mix it intimately with an equal weight of that which favors the gaseous disengagement.

3. To introduce the mixture into a glass tube of the size of a finger, closed at one end and communicating by means of a small tube bent upwards, with a graduated eprouvette nearly full of mercury.

4. To place the tube in an oil bath, or in a bath of fusible metal, according to the degree of heat which will be necessary.

5. To measure the temperature with a mercury thermometer in the oil-bath, and with an atmospheric thermometer in the bath of fusible metal.

6. To agitate the bath, from time to time, so that the temperature should be the same all over.

7. To have an apparatus which would permit of making at least a dozen experiments at one time.

8. To put into one of the 12 tubes only the test body to serve as a term of comparison, and to compare the results which it gives at various temperatures, with those proceeding from mixtures.

All this being done the bath is gently heated, and the thermometer is carefully watched. It is easy to observe, at what degree the disengagement of gas commences, when there is action, and to follow the very variable progress of the phenomena in proportion as the temperature rises.

Sometimes the experiment ceases below 572° F. (300° C.), at other times it requires bright red heat. In all cases, when finished, the residue and the gas should be analysed after being measured.

We have tried many bodies in this way, namely; the metallic peroxides and some protoxides; the principal chlorates, hyperchlorates, bromates, iodates, some nitrates and some sulphates.

The greater part have been separately subjected to the influence of the 17 following bodies.

Two metals.—Silver and platinum. Many others, such as gold, iridium, and palladium, doubtless possess the same property.

Ten oxides.—Oxide of silver, binoxide of mercury, binoxide of copper, binoxide of lead, oxide of bismuth, binoxide of tin, binoxide of manganese, sesquioxide of iron, and oxide of zinc.

We have no doubt, that many other oxides would act in the same manner as the above.

Finally, five other bodies; sulphate of lead, chromate of lead, chromate of silver, fluoride of calcium and pumice stone.

From this it will be seen, that we have made upwards of 300 experiments.

There is always, or almost always, a very manifest action, so far that the mixture often begins to disengage gas at 212° F., before the single body.

It sometimes happens that a body decomposed by another, is itself decomposed by a third, so that it is by turns the decomposed and decomposing body, according to the influence of the body, in contact with which it is placed.

What must we conclude from these observations?

That, as I said before, since the discovery of binoxide of hydrogen, the catalytic force, whatever may be its cause, often contributes to produce the phenomena which result from the reciprocal action of bodies, and which it is essential to take notice of.

When gas is produced, there is no difficulty in ascertaining it with the apparatus of which we have given an idea. But, in other cases, the problem becomes more difficult. We shall enter on it in another memoir, and shall do our best to obtain some results to which no serious objections can be raised.

Comptes Rendus, No. 9, August 27th, 1855.

ORGANIC CHEMISTRY.

On the HYDROCOTYLE ASIATICA. By M. JULES LÉPINE.

In the month of December, 1852, M. Boileau, a medical man in the Mauritius, first called attention to this plant, with which he said he had had good results in the treatment of tuberculous leprosy (see *THE CHEMIST*, New Series, vol. i. p. 303). M. Lépine then hastened to make a chemical investigation of this new medicine, and placed at the disposal of the medical men of Pondicherry the preparations of hydrocotyle, which they required for the purpose of testing its therapeutical value.

In the memoir published by M. Lépine at Pondicherry, he gives first the history of the plant, gives its synonyme, its botanic characters, chemical analyses, pharmacology, and the medical observations to which its employment has given rise. We shall here give an abridgement of that part of the work which treats of the chemical history of the plant, its pharmacology, and the account of its medical properties.

100 grammes of dry hydrocotyle produced, by incineration, 15·625 grammes of ash, having the following composition:—

Chloride of magnesium	0·140
Chloride of sodium	2·277
Chloride of potassium	0·923
Carbonate of potassa, sulphate of potassa, sulphate of soda	2·089
Sulphate of lime	0·351
Carbonate of lime	1·550
Carbonate of magnesia	0·280
Phosphate of lime, phosphate of iron	3·340
Silica	1·660
Sand and charcoal	2·670

The leaves incinerated separately produced 14·08 grammes of ash ;

the roots, 11.62 grs. ; the seeds, 12 grammes. The composition of these ashes only differed in the proportions of the different salts ; the seeds contained no iron, and the proportion of chloride of sodium only amounted to 0.595 gr.

The fresh plant has no odor, it has a peculiar herbaceous taste, slightly bitter and aromatic ; dried in the air, the odor is slightly virous, *sui generis*. When dry it is hygrometric, when exposed to the air the leaves resume their flexibility.

CHEMICAL ANALYSIS OF THE PLANT.

The different portions of the plant have been successively analysed and gave the following results per cent. :—

	Dried and pulverised plant without residue.	Leaves dried and pulverised.	Roots.	Seeds.
	grs.	grs.	grs.	Quant. ind.
Vellarine . . .	0.86	0.15	1.10	6.72*
Yellow oil . . .			1.82	
Green resin . . .	3.76	4.85	"	1.12
Brown resin . . .	4.80	1.30	2.60	"
Saccharine extract .	15.32	2.86	3.96	"
Non-saccharine extract	2.06	13.22	1.20	11.33
Bitter extract . . .	"	"	10.48	"
Gum	3.44	1.58	3.84	0.38
Starch	1.70	3.24	7.60	2.54
Ligneous fibre . . .	68.06	72.80	67.40	77.91
	100.00	100.00	100.00	100.00

1,000 grammes of the fresh plant furnished 760 grammes of unfiltered juice, whose composition is as follows :—

	gr.
Vellarine	0.07
Saccharine extract	7.54
Pectic acid	0.37
Extractive	21.20
Albumen	1.50
Gum	3.68
Starch	0.35
Green resin	0.85
Brown resin	0.30
Sugar	0.21
Liqueous fibre	4.43
Water	719.50
	760.00

* Greenish-brown oil.

EXAMINATION OF THE VELLARINE.

The matter designated *vellarine*, from a native name of the plant, *vellarai*, appears to be the active principle of the hydrocotyle ; it is a thick, pale yellow oil, with a bitter, piquant and persistent taste ; the odor is strong and resembles that of the hydrocotyle ; this oil is soluble in weak alcohol, in ether and the fatty bodies ; it forms an emulsion with water ; the filtered aqueous solution is opaline ; alkalies have no influence upon it ; acids form a white flocculent precipitate ; acetate of lead likewise forms a white precipitate in it. This oil is neuter to test papers when separated from an acid brown resin, which is often difficult to isolate, and which gives it an acid reaction ; it is probable that when perfectly pure, it has an alkaline nature. When placed in dry air it becomes thick and the color deepens ; if the air is damp it liquefies, and forms an emulsion by degrees ; it alters under the influence of heat, and probably under that of the atmospheric agents ; when exposed to the action of the air and heat it becomes brown, and if, in this state, it is dissolved in weak alcohol, it leaves a brown matter undissolved ; lime water divides it into sulphur-yellow grains ; it dissolves in ammonia, and is precipitated from this solution by the acids ; it becomes brown in contact with a solution of caustic potassa, but is insoluble in it, and does not appear to combine with it. It partly dissolves in hydrochloric acid, from which water precipitates it in yellow flocks, when it becomes black with sulphuric acid and dissolves in it ; water precipitates yellowish flocks ; when treated with nitric acid an oily brown substance separates from it, which is insoluble in water. When heated in a glass tube it boils and partly volatilises, disengaging acrid, acid, white vapors, which condense on the inside of the glass in brown, oleaginous drops, having a powerful acid reaction, a carbonaceous residue remains in the tube. The acid which condenses on the sides of the glass, has a very disagreeable taste and smell ; it becomes brown with nitric acid, and black with sulphuric acid.

EXAMINATION OF THE BROWN RESIN.

This resin, dried at 77° F. (25° C.) has the appearance of a brown friable matter ; when reduced to powder, it is of a yellowish grey ; the taste is sharp and bitter ; it is very soluble in alcohol, sparingly soluble in water ; its solutions are acid ; nitric acid dissolves it and gives it an orange yellow color, then it separates from this solution in pale yellow clots. It dissolves in sulphuric acid, assuming a blood-red color. Liquid potassa dissolves it, this solution is an orange yellow ; a solution of carbonate of potassa turns this resin to a maroon color.

When heated in a tube it carbonises, diffusing acid vapors, with an empyreumatic odor ; it gives a voluminous charcoal.

EXAMINATION OF THE GREEN RESIN.

This matter, when heated in a glass tube diffuses acid vapors, liquefies, and is transformed into an oleaginous brown liquid. The charcoal produced is but small. The green resin when exposed to the air dries ; when pure, nitric acid does not change its color ; the green

resin in contact with liquid potassa, becomes liquid at 86° F. (30° C.); saponification does not take place below 212° F.; the soap formed is of a brownish green color, and dissolves in water; dilute sulphuric acid separates a new acid from it, which, when washed with distilled water, dissolves in alcohol of 36°; after the evaporation of the alcohol it appears to be a greenish brown, nearly black, semi-solid matter, with an acid reaction, having the same odor as the acid obtained by heating the green matter in the tube; in this state nitric acid attacks it slightly, and gives it a greenish yellow color; sulphuric acid dissolves it; liquid potassa does not attack it; this matter is soluble in ammonia and alcohol and insoluble in water.

PHARMACOLOGY.

Before giving the formulæ for the employment of the hydrocotyle, we think it advisable to give a summary of the principal facts ascertained in the analysis of the plant; we must likewise observe, that paper steeped in an infusion of hydrocotyle turns yellow with the most dilute alkaline solutions; if we drop a little tincture of hydrocotyle into a glass of water nothing perceptible takes place, but when an alkali is added, the solution immediately assumes a yellow color; carbonate of potassa produces a different effect; because with it the solution, after turning yellow, assumes a brown tint in a short time.

100 grammes of hydrocotyle contains 90 grammes of leaves and stalks, nine of roots and one of seeds.

Roots, when dried at 212° F. lose 50 per cent. of water. The whole plant loses at 86° F. (30° C.) 72 per cent., and at 212° F. 78 per cent. of water.

100 grammes of green hydrocotyle give 76 grammes of juice; from 100 grammes of powder of hydrocotyle, alcohol obtains 28 grs. of extract, of which 2.60 grs. are insoluble in water.

The juice obtained from a quantity of green hydrocotyle, representing 100 grammes of the dry plant, gives 14.85 grs. of extract.

All the fatty matters are removed from the hydrocotyle with ether. The same result is obtained with alcohol at 96° 4' F. (36° C.).

At the temperature of boiling water, the fixed oils dissolve the vellarine contained in the dry plant, but do not appear to dissolve the other principles. If, instead of the dry plant, green hydrocotyle is taken, a small portion of the brown and green resins are dissolved out as well as the vellarine.

Vellarine appears to be the active principle of the hydrocotyle, nevertheless, some of the other substances may be active, but it is difficult to point out their effects. Vellarine partly volatilises at 212° F., it changes under the influence of the atmosphere, heat and moisture; it is likewise observed, that the more the plant and its preparations are exposed to heat the less vellarine they contain; it is therefore advisable, in endeavoring to obtain an active medicament to expose the preparations of hydrocotyle as little as possible to the fire. Thus a decoction of 100 grammes of the plant will only contain 0.16 grs. of

vellarine, whereas the same quantity, infused in a close vessel gives 0·32 gr.

On the other hand, if we compare the total weight of soluble substances, whether in alcohol or in water, given by 100 grammes of the various parts of the hydrocotyle, we arrive at the following results :—

	grs.
The powder	36·75
The entire plant	31·94
The leaves	27·20
The roots	32·60
The seeds	22·09
The purified juice	16·23

We see by this table, supposing that other principles besides vellarine have effect, the seeds contain less soluble matters than the other parts of the plant; that the roots contain more than one-third of their weight of soluble substances.

We must likewise mention, that the green resin disappears entirely in the root, in which it is replaced by the yellow oil. M. Boileau and the other medical men who have used this remedy, have ascertained that the powder was more powerful than the syrup, and the latter more than the tisane; analysis, by attributing the chief activity to the vellarine, explains this observation.

The vellarine may be extracted by the three following processes :—

1. By exhausting the powder with alcohol at 36°, distilling the tincture, separating the green resin, treating the filtered liquid with carbonate of potassa, agitating with ether, decanting the latter, on evaporation we obtain 1 per cent. of vellarine.

2. Exhausting the powder with a solution of carbonate of potassa, then treating with ether, as in the first process. From 60 to 80 centigrammes of vellarine are obtained from 100 grammes of powder; this method of preparation gives a good product, but as the solution of potassa passes very slowly, it takes a long time, because a very great quantity of solution is necessary to exhaust the powder.

3. By treating the impure juice of hydrocotyle with its own weight of alcohol at 33°, filtering, adding a solution of carbonate of potassa, and heating slightly to drive off the alcohol, then agitating the cooled liquor with ether; the ether, on evaporating, leaves 11 centigrammes of vellarine for 100 grammes of green hydrocotyle. This process appears to be preferable to the two others; it is easily performed, and gives a product which possesses in the highest degree, all the chemical and physical properties of vellarine.

FORMULE USED IN THE GOVERNMENT PHARMACIE AT PONDICHERRY.

Powder of Hydrocotyle.

The hydrocotyle is dried in a stove at about 104° F. (40° C.); it is pulverised, and passed through a silk sieve; it is pounded until the residue begins to agglomerate, and will no longer pass through the

sieve. The powder obtained is a pale greenish grey. 100 grammes of hydrocotyle give 80 grs. of powder. Dose, from 1 to 6 grs. each day.

Tisane of Hydrocotyle.

R. Dry hydrocotyle	60 grammes.
Water	2 quarts.

Boil until reduced to half, filter, add 60 grs. of sugar. Dose, one quart per day, to be continued for several months.

Syrup of Hydrocotyle.

R. Green hydrocotyle, any quantity.

Pound the plant, then press it, and take—

Impure juice	16 parts.
Loaf sugar	30 „

Dissolve the sugar, bring it rapidly to the boiling point, pass through a sieve. This syrup keeps well in sealed bottles. Dose, from 1 to 8 dessert spoonfuls each day. It is chiefly valuable for children.

Pommade of Hydrocotyle.

R. Green hydrocotyle	800 grammes.
Lard	1100 „
Yellow wax	400 „

NOTE.—The quantity of wax should be less in temperate climates.

Bruise the plant and let it digest with the grease at a moderate heat, until all moisture disappears (for about two days); press it, add the wax to the ointment, let it melt at a moderate heat and stir until cool. This pommade should be rubbed in round the places, then applied to the places themselves.

Tincture of Hydrocotyle.

R. Bruised hydrocotyle	1 part.
Alcohol at 35°	4 „

Macerate for ten days, subject to pressure and filter.

This tincture is employed by friction; it may likewise be administered internally as a draught. Dose, from 10 to 40 drops per day.

Baths of Hydrocotyle.

Two kilogrammes, 500 grammes of the green plant, or 500 grammes of the dried plant, are boiled for a bath.

FORMULÆ COMMUNICATED BY M. BOILEAU.

Powder of Hydrocotyle.

The plant is to be dried in the shade; when about to pulverise it expose it to the sun.

Syrup of Hydrocotyle.

For a bottle of syrup take two ounces of hydrocotyle, dried in the

shade; then boil it in a sufficient quantity of water, filter, pound the boiled plant, and subject it to pressure; the product thus obtained is mixed with the decoction; a sufficient quantity of sugar is added, and the whole is boiled down to a syrup.

Pommade of Hydrocotyle.

R. Fresh cocoa-nut oil . . .	1 bottle.
Olive oil . . .	$\frac{1}{2}$ bottle.
White wax . . .	Q. S.
Powdered hydrocotyle . . .	3 dessert spoonfuls.

Melt the wax in the oil, add the powder and stir until cold.

Now, what modifications do these various formulæ require, taking the chemical composition of the plant into consideration?

If we still wish to continue the use of the whole plant, the *modus faciendi* of some of these preparations requires some alterations.

For the powder, the pulverisation should be carried as far as possible, for we know that the residue contains more vellarine than the powder itself.

In the tisane, infusion should be substituted for decoction.

The extract, whether alcoholic or with the juice, should not be used. These extracts contain very little vellarine, which is dissipated by the heat, and moreover they are very hygrometric, and are consequently very difficult to keep.

It would perhaps appear more rational, if we consider that vellarine is the only active principle in hydrocotyle, to endeavor to administer this substance alone; but, if we consider its nature and its tendency to spoil when isolated, we shall have to give up this idea. We should therefore endeavor to find what part of the hydrocotyle contains the most of it, and with this view it would, perhaps, be better to substitute the root for the plant itself. We would advise that those who think of using the root of the hydrocotyle, should try some medical experiments, at the same time, with the entire plant; by acting thus, we shall ascertain the real therapeutic value of the root.

For this end we recommend the following formulæ:—

Powder of the Root of the Hydrocotyle.

Dry the roots on a sand bath, and pulverise until there is no residue. Dose, 10 to 40 centigrammes per day.

Pills of the Root.

R. Powder of the root . . .	1 gramme.
Syrup of the hydrocotyle . . .	Q. S.
Make 20 pills. Dose, from 2 to 8 each day.	

Tisane of the Root of the Hydrocotyle.

R. Bruised root . . .	10 grammes.
Boiling water . . .	1000 „

Infuse it for an hour in a close vessel, filter and sweeten.

Alcoholate of the Root.

R. Fresh root	1 part.
Alcohol at 33°	2 „

Bruise the root, macerate it for eight days with the alcohol, press and filter.

Hydroalcoholic Syrup of the Root.

R. Alcoholate of root of hydrocotyle .	20 grammes.
Simple syrup	1500 „

Mix.—Each spoonful of this syrup represents 10 centigrammes of root. Dose, from 1 to 4 dessert spoonfuls each day.

Aqueous Syrup of the Root.

R. Root dried and bruised . . .	150 grammes.
Boiling water	: 1000 „
Loaf sugar	Q. S.

Infuse the root for an hour in a close vessel in boiling water; strain, subject the residue to pressure, filter and make the syrup when cold by simple solution, adding 30 grammes of sugar to 16 grammes of filtered infusion; filter the syrup through paper. Dose, 1 to 4 dessert spoonfuls each day.

Liniment of Hydrocotyle.

R. Cocoa-nut oil	100 grammes.
Powder of the root of the hydrocotyle	10 „

Macerate at a moderate temperature for one hour, strain, press and filter.

Tincture of the Root of the Hydrocotyle.

R. Dried root	1 part.
Alcohol at 35°	5 „

Bruise the root, macerate for 15 days, strain, press the residue and filter.

This tincture may be tried in frictions, in cases of rheumatic gout. Internally, from 1 to 10 drops may be taken every day, mixed in a draught.

Pommade of the Root of the Hydrocotyle.

R. Lard	500 grammes.
Yellow wax	100 „
Fresh root of the hydrocotyle . . .	100 „

Pound the root, macerate it with the lard for two days at a moderate heat, add the wax, melt and stir the whole until cold.

M. Lépine also publishes the medical observations collected in India, respecting the use of this medicine; it results, that the hydrocotyle is a specific in many diseases, and especially in skin diseases; in all the cases of leprosy in which the remedy was administered,

great benefit was obtained. M. Boileau has proved, that many cases of complete cure have been effected. English doctors have likewise made experiments on this plant. Mr. Hunter, who was charged with this task by the Board of Health, at Madras, has collected the facts which he observed in a report of the 28th February, 1854, it is as follows:—

Of 79 cases of leprosy treated, in 23 the patches were cured, and the general health improved; six of these 23 left the hospital in good health, and one recovered immediately after leaving.

Seven cases with patches, health much improved.

Three patients, who ran away while out walking, were very nearly cured.

Six patients, suffering from very severe tuberculous leprosy, obtained no relief.

One case of tuberculous leprosy became worse.

Thirteen cases did not offer any very decided improvement.

Two patients died, one of dropsy the other of consumption.

Twenty-four patients still under treatment, are progressing favorably.

Of 50 patients attacked with various diseases, more than 30 were cured, and all the others had received great benefit. Mr. Hunter thus expresses himself in his report:—

“The affections in which this medicine has been peculiarly efficacious are ulceration, syphilis, and scrofula. Almost all cases of ulceration are cured with this remedy. Among the cures were several cases which had resisted other modes of treatment. This medicine may be recommended as an excellent stomachic and tonic. It appears to have a peculiar action on the capillaries of the mucous surfaces and on the skin, it causes at first a sensation of heat in the stomach, and at the same time a prickling in the extremities, and then over the whole skin of the body, soon followed by an augmentation of appetite and transpiration, and a general improvement in the health.”

We must observe, that the French doctors have given this remedy in such large doses, as to be obliged to interrupt the treatment; the English have obtained excellent results by using this medicine, in the dose of from 75 centigrammes to one gramme of powder per day; it will consequently be necessary in using the hydrocotyle, to diminish the doses mentioned by M. Lépine, which are calculated in accordance with the observations of the French doctors.

Journal de Pharmacie et de Chimie, July, 1855.

INDUSTRIAL CHEMISTRY.**On HYDRAULIC LIMES, ARTIFICIAL STONES, and VARIOUS NEW APPLICATIONS of the SOLUBLE SILICATES.**

By M. F. KUHLMANN.

Fixation of the Potassa in Silicious Painting.—The application of painting on calcareous stones, by means of silicate of potassa, enables us to explain how, after exposure for some time to the air, the colors become entirely insoluble in water. The contact of carbonate of lime with silicate of potassa, always determines the decomposition of this salt and its transformation into silicate of lime, which retains the coloring matter and even carbonic acid, as lately supposed by M. Fuchs; but when the colors are applied on bodies which do not react on the soluble silicate, such as wood, iron, glass, &c., it becomes necessary to seek for conditions of insolubility in the reaction of the coloring matter on this silicate. On wood the difficulty may be removed by the application, before the silicious painting, of a sufficiently thick covering of chalk, which may be applied with zinc, or fixed with a very little silicate.

Even when the decompositions of the alkaline salt are determined by the coloring matter itself, there still remains one serious inconvenience; this is the exudation, during damp weather, of carbonate of potassa, to the complete expulsion of this salt. I have for a long time sought for a remedy for this serious injury to silicious paintings; I have often conferred on this subject with those members of the Academy who are best acquainted with vitrification, and have been aided by their advice. I have sought in various chemical reactions for a remedy; I have ascertained that washing the painting with a weak solution of hydrochlorate of ammonia, enables us to attain absolute insolubility of the color, but chloride of potassium remains, which spoils its brilliancy until its complete expulsion by repeated washing; as the number is but small of chemical reagents, which have the property of consolidating potassa by forming with it insoluble compounds in the color itself, but without eliminating it, perchloric acid and hydrofluosilicic acid, are the chemical agents which first offer themselves to the mind.

In a theoretic point of view there only remained to choose between them, but in an industrial sense hydrofluosilicic acid was the only one on which my mind fixed itself. I ascertained so frequently, that careful washing with hydrofluosilicic acid much augmented the stability of these colors and determined their complete insolubility, that I do not hesitate to point out the utility of this agent in every kind of silicious painting, but especially in painting on glass, provided that it is used in very weak solution; for in the concentrated state it has the remarkable property of dissolving most of the oxides, which property will be very valuable for industrial purposes, when this acid can be sold at a moderate price.

The silicious colors on glass have a certain semi-transparency which it is important to preserve, but which gradually diminishes by the

action of water. Glass painted with silicates have been subjected to boiling in water, without the colors being detached; these colors have even appeared brighter when seen by reflected light; but if, after this apparent improvement, the effect is examined by transparency, the colors are found to have become duller, which I attribute to the opacity which they had acquired, resulting from the solution of a portion of silicious cement, which acts on these colors as oil acts on paper. The careful use of hydrofluosilicic acid gives a complete insolubility to paintings on glass; but like hydrochlorate of ammonia, it slightly diminishes their transparency. We might perhaps apply, at long intervals, a slight varnish of pure silicate of potassa to paintings on glass which are exposed to the rain. Long experience can alone determine this point. This varnish would advantageously replace the essences now used in the application of certain colors on glass and porcelain; it would not be subject to the drawback, which the essences are, of spoiling certain colors by the reduction of the oxides or of the coloring salts.

Fluosilicatisation of Stones.—In all these researches, after avoiding soda in the preparation of the silicates to prevent efflorescences, I was always uneasy as to the mischief which might be caused, sooner or later, by the presence of potassa or carbonate of potassa, not only to the silicious colors, but also in the silicatised stones. Having, however, kept silicatised stones since 1841, without any alteration, I have attained a feeling of perfect security on this point. Moreover, as this uneasiness was shared by many chemists, and as a great moral responsibility remains on me, especially since Marshal Vaillant has ordered the application of this silicatisation in many public works, and that it is now being employed in the consolidation of the new works of the Louvre, I have used every effort to fix or eliminate the potassa.

I did not consider it sufficient to manufacture silicate of potassa with such economy and on so large a scale, as would enable each architect to silicatisé his work at a price which should not exceed one franc per square metre of surface. I wished to avoid all mistakes, and to have an answer to each objection.

What I had done to fix potassa in paintings, I applied to the silicatisation of calcareous stones, even if the silicate had been too alkaline.

After the hardening of the soft and porous calcareous stones by their partial transformation into silicate of lime, I wished to assure the insolubility of the potassa still retained by the stones, by impregnating them with a solution, at first dilute, but afterwards more concentrated, of hydrofluosilicic acid, which penetrates the stone and forms, with the potassa, an insoluble compound which is well known by chemists.

I have given the name *fluosilicatisation* to these successive reactions, which are destined to preserve our edifices from the consequences of the superficial injection of a fixed alkaline matter, which, if it does not in the end lead to nitrification, in consequence of the density which the stone acquires, and its impermeability to air and ammoniacal emanations, tends to render walls of houses so hygrometric as to endanger the health of the inhabitants.

These results having been attained, I turned my attention to another important point.

If the employment of hydrofluosilicic acid was efficacious in fixing potassa, might not this acid be used directly to produce fluosilicatisation?

Hydrofluosilicic acid in contact with lime, dissolves a certain quantity without any immediate precipitation of fluoride of calcium, and without separation of silica; but when a certain point of saturation is reached, any further addition of lime entirely decomposes the hydrofluosilicic acid, displacing all the solidifiable constituent principles, so that no trace of these bodies remains in the liquid. I have ascertained that when carbonate of lime is substituted for quicklime, the same results are produced; and the silicium and fluorine, by penetrating the calcareous stone, augment its hardness, in a slower manner, it is true, than by using silicate of potassa alone. This is fluosilicatisation in its simplest form, by a reaction which is as easy to understand as to perform in our works, whether of construction or of restoration, and which leaves no cause for inquietude as to any subsequent reaction.

To diminish the slightly corrosive action which may be produced by the first contact of the acid with the calcareous stone, and to remove any fear of alteration in sculptures, I saturate a portion of the acidity by means of chalk, stopping only when precipitation commences. It would not be prudent to perform this saturation long before using the liquid; for the latter, when thus saturated, deposits gradually a portion of the petrifying principles which it contains. The action of the hydrofluosilicic acid on the plaster takes place almost instantaneously, and by simple contact without heat, and the surface of the plaster hardens perceptibly; but if the injection of the acid is abundant, the plaster soon becomes covered with rough lumps, due to the formation of a certain quantity of bisulphate of lime, the sulphuric acid not being expelled, as is the case with the carbonic acid in the treatment of calcareous stones.

In a later portion of this work, I shall enter into the details of the best processes for the production of silicates of potassa and soda, whether by the dry way or by the humid way, and the elements for the manufacture of hydrofluosilicic acid on a large scale.

With respect to this last product I shall easily prove, that it may become an industrial agent, whose applications will become more general as the conditions of its production become more economical.

I shall conclude these investigations by some considerations deduced from the examination of various chemical compounds, whose existence has been mentioned in the various useful applications which I have described. I shall examine the composition peculiarly of sulphate of lime and the various metallic oxides, which penetrate more or less deeply into stone, by the contact with heat of carbonate of lime and various sulphates, and the generalisation of this action with other carbonates; in the second place, I shall mention the state in which silica and potassa or soda are found in silicatised calcareous stones, and the

insoluble colored compounds which constitute the base of silicious paintings; finally, I shall analyse the reaction which results from the contact of hydrofluosilicic acid with an excess of carbonate of lime, and which leads directly to very considerable hardening of calcareous stones.

Comptes Rendus, No 8, August 20th, 1855.

On the EXTRACTION of CAOUCHOUC. By M. WEDDELL.

CAOUCHOUC may be obtained from a great many plants, but those which yield it in any abundance are comparatively few in number. They belong to the natural orders Artocarpeæ, Apocynaceæ, and Euphorbiaceæ, and inhabit all the warmest parts of the earth.

In *Artocarpeæ* we have,

Castillea elastica (Cerv.) of Mexico,

Cecropia peltata (Linn.) of Tropical America,

And various fig-trees of Asia and America, of which, however, *Ficus elastica* is the only important one, being the principal source of caouchouc in the East Indies.

In *Apocynaceæ* there is,

Urceola elastica (Roxb.) which furnishes the Borneo and Sumatra India-rubber, known in commerce as Singapore or Pulo-Penang India-rubber.

Vahea gummifera (Poir.), the source of Madagascar Indian-rubber; and *Hancomia spinosa* (Gomez.), from which I saw a large quantity collected in the interior of the Brazils.

Belonging to *Euphorbiaceæ* we have the well-known *Siphonia elastica*, or *Hevea guyanensis*, which yields the largest amount of commercial caouchouc, known in commerce as Para Indian-rubber, from its being imported from Para, a small port situated at the mouth of the Amazon river.

This tree, which grows extensively on the plains of the Oronoco and Amazon rivers, will be the one to which my remarks will be exclusively confined. *Siphonia elastica*, or the Syringe-tree* of the Brazils, generally averages 65 to 67 feet in height, frequently reaching 40 to 50 feet before a single branch is given off. The diameter varies from 30 to 40 inches.

These dimensions, however, are frequently met with in trees which

* The origin of this name is given in *L'Histoire de l'Académie Royale des Sciences*, 1751, page 18, in the following terms:—

“The Omaquas, a tribe inhabiting the borders of the Amazon river, make an extraordinary use of this exudation. They form it into pear-shaped bottles or bulbs, in the neck of which they fasten a hollow wooden tube; upon filling the bulb with water, and then pressing it with the hand, the water is forced out at the mouth of the tube, forming in this way a complete syringe. It is considered by these people an ordinary mark of politeness for a host to present to each of his guests one of these bottles filled with warm water, and which they do not fail to make use of before sitting down to dinner. This strange custom has led the Portuguese to name the tree which produces this resin, *Pas de xiringa*, or syringe wood.”

inhabit the tropical forests, but the peculiarity of its foliage, each leaf being composed of three elongated leaflets, together with the abundance of milky juice it yields upon incision, easily distinguishes this tree from all others growing around it.

Nothing could be easier than the method of collecting and preparing caouchouc. The workman goes early in the morning into the forest, provided with a hatchet, a calabash, and a quantity of soft clay. Arriving at the foot of a *Siphonia*, he fastens round its base, by means of the clay, a small glazed dish, resembling in shape a swallow's nest, and with his hatchet severs the bark immediately above the dish. The milky sap immediately exudes, and is collected in the dish below. When a sufficient number of trees have been treated in this way, the workman collects the contents of the little dishes in his calabash and returns home with his booty.

The quantity of sap yielded by one tree naturally varies, but on an average, 20 trees yield two pints; and, when well managed, the same trees will yield daily the same quantity during a period of some months.

A traveller tells me, that being on the borders of the Amazon river, he stopped a day in the cottage of a caouchouc collector, and about mid-day he saw his host returning with a calabash, which contained eight pints of *siphonia* milk, a quantity sufficient for the manufacture of ten pairs of shoes. His daughters, who were less practised than himself, had during the same period collected four pints, which is the average quantity for one workman. I have mentioned shoes, because in that form, or as round and egg-shaped bottles, tubes, and sheets, the larger quantity of Indian-rubber is still exported from the Brazils. The bottles are made by dipping a ball of clay, fastened to the end of a stick, into the fresh juice, and immediately afterwards holding it in a thick smoke, produced by the combustion of oleaginous seeds. When the first layer has partially solidified, others are applied in the same manner till a sufficient thickness has been obtained. Shoes are made in the same manner, with the exception that a wooden mould, thinly coated with clay, is employed—as it admits of being withdrawn without breaking. Ten minutes is generally sufficient for a clever workman to make a pair of shoes. I must mention, however, that the effect of the smoke is to coagulate the caouchouc. The hardening is afterwards effected by exposure for some time to the sun.

Some experiments have recently been made with the view to the exportation of this substance in the liquid state, by inclosing it in hermetically sealed bottles. Upon opening these bottles, however, a solid mass of caouchouc, floating in a serous liquid, presents itself. If the milky sap, as first extracted, be allowed to stand for some time, it separates into two portions in the same manner as milk; a substance which it closely resembles in appearance and taste. It may also be drank without any injurious effects being produced.

The most favorable period for extracting caouchouc is the summer season, from April to November. During the wet weather the work in the forest is very difficult and unhealthy. The product also is very

inferior, containing much less of its solid coagulable constituents. During the collecting season the trees have to be wounded afresh every day; it therefore becomes necessary to make the first incisions as low down as possible, because also, the old wounds in healing frequently form a sort of swelling round the part which would absorb a portion of the descending sap.

The quality of these trees varies greatly, some yielding more than others; generally, however, the more sap there has been abstracted, the more the tree seems capable of yielding. In this respect these trees resemble good cows.

The preceding facts will be sufficient to prove that the method adopted by the Africans, Indians, and South Americans for obtaining caouchouc, is at once simple and efficacious. Every fact in the history of this substance is calculated to stimulate the activity of an intelligent explorer, and assures us of the future prosperity of one of the most interesting branches of American commerce.

Pharmaceutical Journal.

AGRICULTURAL CHEMISTRY.

RESEARCHES on the COMPOSITION of FODDER.

By M. ISIDORE PIERRE.

SINCE the publication of the first part of this work (see vol. ii., p. 486), I have made fresh investigations on ordinary green fodder, and particularly on various plants frequently used as green fodder in certain countries, although, as far as I know, they have never been the object of any particular cultivation. These were formerly so very abundant that the farmer has found it worth his while to destroy them, and I have endeavored to ascertain, whether they might not prove highly nutritious. Such are the mistletoe of fruit trees, nettles and common thistles. These plants are frequently employed for the alimentation of animals, especially of milch cows. I wished therefore to ascertain, whether the principles generally admitted by theorists in the nutritive value of fodder, would be found in accordance with these very numerous and old established practical facts.

Mistletoe of Apple and Pear Trees.—I have often heard say, when I was in Normandy, that cows were very fond of mistletoe, and that they would run any distance if they were offered a piece of mistletoe; some intelligent dairy-women have likewise affirmed, that mistletoe improved the quality of the milk and strengthened the cows; it was likewise kept very much for those who had lately calved. I consequently procured, this spring, a certain quantity of mistletoe of some cider apple trees, on which it is often very abundant, much to the detriment of the trees, which it exhausts. After having removed those parts which were too hard to be easily eaten, representing about one-fifth of the mistletoe, I divided the remainder into two portions, namely, 1st, the leaves and tips of the fresh shoots; 2nd, the stalks

from which these parts had been removed. The first lot was 66·3 per cent. of the total weight; the second lot 33·7 per cent.

FIRST LOT.—*Leaves and Young Shoots.*

	Per cent.
Loss by dessiccation	64·9
Dry matter	35·1
Nitrogen per cent. of dry matter, 1st estimation	2·56
Ditto 2nd „	2·61
Mean	2·59
Nitrogen per cent. of fresh matter	0·91

SECOND LOT.—*Stalks without Leaves.*

	Per cent.
Loss by complete dessiccation	58·7
Dry matter	41·3
Nitrogen in the dry matter, 1st estimation	2·33
Ditto 2nd „	2·41
Mean	2·37
Nitrogen per cent. of the fresh matter	0·98
Richness of the entire misletoe when fresh	0·93
Richness in the dry state	2·50

Whence it results, first, that the *fresh misletoe* in the middle of spring, is one of the richest and least aqueous fodders hitherto known; secondly, that almost all parts of the misletoe contain nearly the same amount of nitrogen in the green state, and that in the dry state there is but a slight difference between the amount of nitrogenous matter contained in the young shoots and the old shoots, which are still sufficiently tender to be eaten by animals; this is a fact which I have never observed in any other kind of fodder. If we add, that some apple trees bear four or five sprays of misletoe, and that these sprays weigh several kilogrammes, it will easily be understood that when fodder is scarce, a crop of misletoe may in some countries provide such a resource for fodder as is by no means to be despised, besides relieving the plants from a very exhausting parasite. One farmer alone collected 500 kilogrammes of misletoe off sixty apple trees, to the great satisfaction of his milch cows.

Thistle.—The common thistle, which often drives the careful farmer almost to despair, is frequently employed as nourishment for milch cows in the spring; and if agriculture in general endeavors to destroy it, still the wives of the small farmers find it a great resource in the spring; they cut it even with the earth, which by no means aids its destruction, as it afterwards throws up a number of stems instead of only one.

I have examined the thistle at three different periods of its vegetation; 1st. When about 10 or 15 centimetres high. 2nd. When having attained the height of 25 centimetres, it still showed no trace

of buds. 3rd. When on the point of flowering, having attained the height of from 50 to 75 centimetres.

1st.—*Thistles from 10 to 15 centimetres high (very tender).*

	Per cent.
Loss by complete dessiccation	88
Dry matter	12
Nitrogen per cent. of dry matter, 1st estimation	4.58
Ditto 2nd „	4.75
Mean	4.67
Nitrogen per cent. of fresh thistle	0.56

In this state, still containing 88 per cent. of water, thistles may be considered as equal to the best green fodder; but it is not generally given to animals in this state, as they would only eat it with hesitation; it is exposed to the air or sun for some hours so as to fade it a little, and thus the thorns lose a portion of their rigidity, then the animals like it very much. This slight fading has deprived them of 18 to 22 per cent. of water; we will say in round numbers 20 per cent. The amount of nitrogen is then from 0.56 to 0.70 per cent.

2nd.—*Thistles 25 centimetres in height, without blossom.*

As in the former case, these thistles were taken entire and cut level with the ground.

	Per cent.
Loss by complete dessiccation	88.9
Dry matter	11.1
Nitrogen per cent. in the dry matter, 1st estimation	3.95
Ditto, 2nd estimation	3.85
Mean	3.90
Nitrogen per cent. in fresh thistles	0.43
Nitrogen per cent. in thistles which are a little faded to render them eatable	0.54

3rd.—*Thistles about to flower (from 50 to 75 cent. high).*

	Per cent.
Loss by complete dessiccation	88.1
Dry matters	11.9
Nitrogen per cent. of dry matters, 1st estimation	3.21
Ditto 2nd „	3.17
Mean	3.19
Nitrogen per cent. of fresh thistles	0.38
Nitrogen per cent. of eatable thistles	0.48

The results of these analyses show us:—

1. That the entire thistle, taken when about to flower, and given to animals after having lost 20 per cent. of the water which it contains,

is equal to the ordinary kinds of green food, with respect to the amount of nitrogen contained in it.

2. That it is rather richer in nitrogen three weeks before.

3. That when it has attained the height of only 10 to 15 centimetres, it may be placed in the same rank as very good green food.

From the end of April until the end of June, namely, for two months and sometimes longer, the tender green thistle may be given to milch cows, and the enormous quantity which they eat in some parts, explains why among a people who are in some sort interested in preserving them, the directions respecting the destruction of thistles seldom produce any very important results. Notwithstanding the advantages presented by thistles as food, I am not inclined to recommend their cultivation, too much can always be found without; but it appears to me, that with this theoretical justification of the practical benefit of them, their consumption might be carried to such an extent as to restrain their reproduction very materially.

Common Nettle.—The common nettles, either alone or mixed, are very frequently employed in feeding some kinds of poultry, pigs, milch cows, and even horses. I have known several farmers' wives who have given them to their milch cows, frequently renewing them when they could be obtained in considerable quantities, and it is well known that in most covered countries, the hedges seldom are wanting in nettles; they likewise grow wild under walls. When it is intended to give the nettles unchopped, the same precaution should be taken of partly fading as has been advised for thistles, exposure to the air and sun for an hour or two destroys the irritating substance secreted by the leaves. By this operation the nettles lose about 20 per cent. of water.

I.—Very tender Nettle, height (30 centimetres).

	Per cent.
Loss by complete dessiccation	84·02
Dry matter	15·08
Nitrogen per cent. of dry matter, 1st estimation	5·35
Ditto 2nd „	5·46
Mean	5·41
Nitrogen per cent. of fresh nettle	0·85
Nitrogen per cent. of eatable nettle	1·06

II.—Nettle in full blossom, cut at the same place six weeks later (it was cut high, at about 35 to 40 centimetres from the top of the stalks).

	Per cent.
Loss by complete dessiccation	78·8
Dry matter	21·2
Nitrogen per cent. of dry matter, 1st estimation	3·35
Ditto 2nd „	3·45
Mean	3·40
Nitrogen per cent. of fresh green nettles	0·72
Nitrogen per cent. of eatable nettles	0·90

By its richness in nitrogen, the common nettle, especially when tender, deserves to be placed with mistletoe in the first rank of green food, and theory fully confirms the common practice in this respect.

As dried food, containing about 20 per cent. of water, nettles are richer in nitrogen than any other known food. I do not know whether they have ever been given in this form, but several farmers have promised to try the experiment for me during the next winter.

Hitherto, nothing but the very young leaves of the mulberry have been found, which contains, in the dry state, more nitrogen than the whole stalks of the tender nettle of about 30 centimetres in height, which I tried. I was curious to ascertain, whether the tops composed only of the very youngest leaves would not be richer, and whether they may not be the food richest in nitrogen hitherto known, even more so than the young mulberry leaves analysed by M. Payen. The beautiful investigations of this learned man, so often confirmed in the course of my present researches, rendered this result very probable. Direct experiment gave the following result :—

Nitrogen per cent. of dried matter, 1st estimation		Per cent.
Ditto	2nd	„
Mean		
		6.53
		6.48
		6.50

Consequently, the young nettle leaves contain more nitrogenous matter than any leaves hitherto analysed, and even more than any other known alimentary vegetable.

It still remains for us to ascertain, whether this richness in nitrogen depends on the nature of the soil which produces it, the climate, &c., and in what degree ; this is an investigation which will require the simultaneous concurrence of many experimentalists.

Comptes Rendus, No. 5, July 30, 1855.

PHOTOGRAPHY.

INSTANTANEOUS POSITIVE PAPER. By Mr. H. CLAUDET.

I FIRST make a saturated solution of bichloride of mercury (corrosive sublimate), for example 1 ounce, two-thirds of which I mix with about 1 pint of distilled water. I prepare the paper in this solution by pouring the latter into a flat dish and floating the paper over it. When the paper is dry, I render it sensitive by means of a solution of nitrate of silver in distilled water (38 grains to the ounce). The last preparation must be made in a dark place, with the light of a candle alone, the flame of which is covered by a yellow glass. This paper I expose for about 2 to 10 seconds in summer, and about 1 minute in winter. To effect this operation satisfactorily, it is requisite to place the negative on the prepared paper in the frame, by the aid of the yellow light, to cover the frame with a black cloth, and when it is brought into the place of exposure, to arrange the frame so that the rays may fall as nearly as possible perpendicularly upon it ; then to remove the black cloth, which

is replaced as soon as the time of exposure has expired. The image appears very feebly when the paper is taken from the frame, but it is fully developed by means of a solution of sulphate of iron, 15 grains to the ounce of distilled water, to which about 25 grains of glacial acetic acid are added. This development must be watched, and arrested at the proper moment. The positive is then immediately washed, and fixed with hyposulphite of soda. This operation occupies about 15 minutes. By this process I obtain a fine neutral black tint. Unfortunately, I have not time at disposal to continue these experiments, but I communicate what I have done, hoping that this may be of service to those who are obliged to copy in winter, and are stopped, as it were, by bad weather.

Photographic Journal.

EXPERIMENTS on ACIDS capable of replacing ACETIC ACID, as an addition to PYROGALLIC ACID in REDUCING SOLUTIONS.

By MM. GIRARD and DAVANNE.

ACIDS may exercise different influences in a photographic point of view.

1. May possess no action on pyrogallie acid, which then completely blackens the proof.

2. May annul its developing action, so that the impression does not appear.

3 May moderate its action and permit the image to develop more or less completely, or more or less rapidly.

1. The acids without influence on the pyrogallie solution are not numerous; they are,—

Carbonic,
Boric, and
Tannic acid.

2. The acids which completely obstruct the development of the image are much more numerous, and experience has shown us that all those which gave an insoluble precipitate, when added to nitrate of silver, must be brought into this category; they are,—

Hydrochloric.

Hydrobromic.

Hydriodic.

Hydrotelluric. { These two are mentioned from memory;

Hydroselenic. { we have not been able to try them.

Prussic or Hydrocyanic.

Hydrosulphuric. (This immediately forms a black sulphide of silver.)

Phosphoric.

Arsenic.

Oxalic.

Sulphurous.

Iodic (which is immediately decomposed by pyrogallie acid), chromic,

and bromic acids are decomposed too rapidly to allow of our answering for their action.

We may remark, in passing, that in these experiments there always existed, on the one hand a surface of iodide of silver, impressed by light, on the other an energetic developing agent, pyrogallie acid; however, the addition of a body, which, without decomposing either, took possession of all the free nitrate of silver remaining on the surface of the glass, always sufficed to destroy all trace of the image. This fact, corroborated by so many others already known, would seem to indicate that developing agents only have power in the presence of free nitrate of silver, however minute the quantity.

3. Acids which when mixed with pyrogallie acid moderate its action, at the same time allowing the image to appear more or less rapidly, and more or less clearly.

Among the mineral acids may be cited,—

Sulphuric.	} These acids have only given us gray proofs, deficient in strength.
Nitric.	
Perchloric.	

Arsenious acid, added even in very small quantity, rapidly gives an intense general black color, after having developed the image.

Among the organic acids we may cite,—

Acetic.	Succinic.
Citric.	Formic.
Malic.	Tartaric.
Benzoïc.	
Camphoric.	
Gallic.	

The first six succeeded best.

Acetic, malic, and succinic acids appear to have the same action; the proportion may be varied in a very strong degree without any very notable difference in the results.

Citric acid, on the contrary, develops the image the more slowly, for the same exposure, in proportion as the amount of acid is more considerable, and we imagine photographers may derive an excellent advantage from this property; for often, especially in summer, the action of pyrogallie acid mixed with acetic acid is so energetic, that there is scarcely time to restrain the development of the image, while with citric acid, the image is developed more slowly and more equally at all points, and it is more easy to arrest the operation at will.

The time of exposure should be rather diminished than increased. Finally, the citric acid extending itself in perfectly uniform layers, wetting the glass better, there is not the same danger of the streaks which acetic acid often gives; the image formed remains negative, and does not turn positive.

The proportion of citric acid may be varied according to the result desired, from 1 grain to 10 grains to 2 fluid ounces of (saturated) solution of pyrogallie acid*.

* These quantities are given in round numbers.—(*Trans.*)

The trials with tartaric acid gave vigorous proofs, but they appeared to have less clearness.

Malic acid, tried in the proportion of 2, 4, 8 and 15 grains to 1 fluid ounce of pyrogallic solution, behaved, as we have said, like acetic acid; the fragments of a glass plate cut up into four, were developed with equal rapidity; the malate of silver being but slightly soluble, there forms in the liquid a precipitate which is more abundant in proportion as the quantity of the malic acid is greater; the excess of acid thus becomes neutralized, and it is not surprising that the results should be much the same

Succinic acid, used in the proportion of 1, 2, 4 and 8 grains to 1 fluid ounce of pyrogallic acid, made the images appear very rapidly and perfectly defined; when fixed, these images have a great tendency to turn to positives.

Formic acid gave us results inferior to the above acids; moreover, its disagreeable odor would be sufficient to prevent its use.

The object of the present paper is not to add a new formula to the already too numerous lists possessed by photography, and above all the collodion process, but to class the acids in a kind of summary, to facilitate further researches.

In the discussion upon this paper at the meeting of the French Photographic Society, the president (M. Regnault) spoke in favor of the use of citric acid. M. Davanne said, perhaps the only objection to it was its slowness, but this might be considered by many as an advantage, allowing the development to be watched. Another point is, that the citric acid produced permanent *negatives*, not turning to positives. M. P. Girard, in answer to some observations by M. Regnault, said that he had used citric acid in paper processes, but not so successfully as with collodion. M. Regnault spoke against the addition of nitrate of silver to developing solutions, as rendering the pictures unnaturally hard. M. Durieu said, he had always found that the addition of nitrate of silver to gallic acid gave damp paper a granular marking.

Photographic Journal.

METHYLIC COLLODION.

ALLOW me, through the medium of your Journal, to call attention to the use of pyroligneous spirit (wood-naphtha, methylic alcohol) as a solvent for various purposes in photography.

During some experiments on the preparation of varnishes for collodion negatives, I was incidentally led to the discovery of the property possessed by wood-spirit of dissolving gun-cotton in large quantity; and this induced me to try its application to the manufacture of collodion. The results, although not at present completely satisfactory, may still be interesting as indicating the possibility of employing a cheaper substitute for ether in this all-important photographic agent.

Gun-cotton, or explosive paper, dissolves readily in wood-naphtha, producing a solution of the same general properties as ordinary collodion,

and which, like it, may be iodized by the addition of iodide of ammonium. When poured on a glass surface it evaporates, but more slowly, owing to the less volatile nature of the solvent, and leaves a film, which, after a short time, or by the application of heat, becomes tough and coherent. In this particular I was disappointed in my earlier trials, being unable to obtain a coating of sufficient tenacity to resist the action of the nitrate of silver bath; or in one or two instances, after having developed the image, the film became detached during the subsequent fixing process, when it was found that very tolerable positive pictures were imprinted on the glass itself.

These failures were at once attributed to the presence of water in the sample of commercial wood-naphtha employed for dissolving the gun-cotton; and on preparing myself a perfectly anhydrous specimen (by distillation from fused chloride of calcium, caustic potash, or lime), I succeeded in producing a collodion, which, after being allowed to dry in the air, exhibited but a slight tendency to separate from the glass during immersion in the silver bath, or if previously heated slightly, face downwards, showed no greater weakness than ordinary collodion.

With regard to sensitiveness, I find the methylic collodion fully equal to that prepared in the usual way; the same may be said also of its capability of producing intense negatives, but for positives it is scarcely well adapted, as in my hands it has usually left a slightly opalescent film. Its great drawback, however, is the disagreeable smell attending its use; this will, I expect, limit its application to cases where, from the large surface to be covered, economy is a more serious item than in the ordinary practice of the art; and in communicating these experiments, my object has been rather to call attention to the possibility of finding other solvents for gun-cotton, in the hope of leading to further results in that direction, than to confine myself to the narration of stated formulæ in the present instance.

Before concluding, let me recommend the use of wood-spirit for cleaning off indifferent collodion pictures: it matters not whether they have been varnished or even coated with Brunswick black; being a solvent for all these substances, they are quickly removed by washing the plates with a tuft of cotton wool dipped in the spirit.

Its employment for the cleansing of bottles from collodion residues will suggest itself when the occasion arises.

I am, Sir,

Yours very respectfully,

JOHN SPILLER.

Museum of Practical Geology,
August 13th, 1855.

Photographic Journal.

PUBLIC HEALTH.*On PLATINISED CHARCOAL.*

BY DR. JOHN STENHOUSE, LL.D., F.R.S.

THE lighter kinds of wood charcoal, owing to the nine volumes of oxygen gas contained in their pores, possess a considerable power of oxidising the greater number of easily alterable gases and vapors. The absorbent power of charcoal, however, is comparatively much greater than its capacity for inducing chemical combination. In this respect, charcoal presents a remarkable contrast to spongy platinum, which, though inferior as an absorbent for some gaseous substances,—such for instance as ammonia, of which spongy platinum absorbs only 30 volumes, while charcoal absorbs 90,—is, nevertheless, immensely more effective, both as an oxidiser, and as a promoter of chemical combination generally. As it is desirable for some purposes, while retaining the absorbent power of charcoal unimpaired, to increase its oxidating influences, it struck me that this important object might be easily effected by combining the charcoal with minutely divided platinum. In this way, a combination is produced to which I have given the name of platinised charcoal, which possesses the good properties of both its constituents. In order to platinise charcoal, nothing more is necessary than to boil the charcoal, either in coarse powder or in large pieces, in a solution of bichloride of platinum, and when the charcoal has become thoroughly impregnated with the platinum, which seldom requires more than ten minutes or a quarter of an hour, to heat it to redness in a close vessel—a capacious platinum crucible being very well adapted for this purpose. When 150 grains of charcoal were impregnated with nine grains of platinum, by the process just described, the charcoal was found to have undergone no change in its external appearance, though its properties had been very essentially altered. When a few grains of this platinised charcoal were passed up into a mixture of dry oxygen and hydrogen in the proportions to form water, over mercury, the two gases rapidly combined in the course of a few minutes, precisely in the same way as when a clay ball of spongy platinum is employed. When, however, a fragment of charcoal containing a considerably larger proportion of platinum was passed up into a similar gaseous mixture, the gases instantly combined with explosive violence, just as if platinum-black had been used. If pieces of cold platinised charcoal are held in a jet of hydrogen, they speedily become incandescent, and inflame the gas. Platinised charcoal, when slightly warmed, likewise rapidly becomes incandescent in a current of coal gas, but the jet of gas is not inflamed, owing to the very high temperature, a white heat, which is required for this purpose.

In the vapor of alcohol or wood-spirit, platinised charcoal becomes red hot, and continues so till the supply of vapor is exhausted. In the course of a few hours, spirits of wine, in contact with platinised charcoal and air, is converted into vinegar. I find that two per cent. of platinum is sufficient to platinise charcoal for most purposes. Charcoal containing this small amount of platinum causes a mixture of oxygen and hy-

drogen to combine perfectly in about a quarter of an hour, and this is the strength of platinised charcoal that seems best adapted for charcoal disinfectant respirators. Charcoal containing one per cent. of platinum causes a mixture of oxygen and hydrogen to combine in about two hours; and charcoal containing the extremely minute quantity of $\frac{1}{4}$ per cent. platinum, produces the same effect in from 6 to 8 hours. Platinised charcoal seems likely to admit of various useful applications: one of the most obvious of these is its excellent adaptability to air-filters and respirators for disinfectant purposes. It is plain that no easily alterable organic vapors, such as effluvia or miasmata, can remain in contact, even for a few minutes, with platinised charcoal, without being destroyed, their carbon being converted into carbonic acid and their hydrogen into water.

Platinised charcoal also seems likely to prove a highly useful application to malignant ulcers and similar sores, on which I confidently expect, from its powerful oxidating properties, that it will act as a mild but effective caustic. Perhaps, however, as an application to sores, platinised asbestos, either alone or in combination with platinised charcoal, might be found more manageable. In those diseases also where the internal use of charcoal has been found beneficial, I should think that platinised charcoal may be advantageously substituted. In Bunsen's carbon battery also, the employment of platinised charcoal may, I think, be advantageously tried.

It is clear that the amount of platinum in the charcoal may be varied almost at pleasure, according to the strength of the platinum solution employed in its preparation, and the purposes to which the charcoal is intended to be applied. Almost any form, and even very considerable dimensions, may be given to the platinised charcoal,—circumstances which greatly extend the range of its applications.

Quarterly Journal of Chemical Society.

CHINESE METHOD of SCENTING TEA.

A FEW years ago I sent you an account of the Chinese method of dyeing teas with Prussian blue and gypsum, to suit our depraved tastes in England and America. I shall now endeavor to describe a much more agreeable and rational manufacture—namely, that of scenting teas. That it is so in the eyes of the Chinese, may be gathered from the fact, that while they *dye* their teas not to drink, but only to sell, they consume and appreciate highly these scented teas. The following account of this interesting process is copied from my journal:—

“I have been making inquiries for some time past, about the curious process of scenting teas for the foreign markets; but the answers I received to my questions were so unsatisfactory, that I gave up all hopes of understanding the business until I had an opportunity of seeing and judging for myself. During a late visit to Canton, I was informed the process might be seen in full operation in a tea factory

on the island of Honan. Messrs. Walkinshaw and Thoburn, two gentlemen well acquainted with the various kinds of teas sent annually to Europe and America, consented to accompany me to this factory, and we took with us the Chinese merchant to whom the place belonged. I was thus placed in a most favorable position for obtaining a correct knowledge of this curious subject. When we entered the tea factory, a strange scene was presented to our view. The place was crowded with women and children, all busily engaged in picking the stalks and yellow or brown leaves out of the black tea. For this labor each was paid at the rate of six cash a catty, and earned on an average about sixty cash a day, a sum equal to about threepence of our money. The scene altogether was not unlike that in the great Government cigar manufactory at Manilla. Men were employed giving out the tea in its rough state, and in receiving it again when picked. With each portion of tea a wooden ticket was also given, which ticket had to be returned along with the tea. In the northern tea countries, the leaves are carefully weighed when they are given out and when they are brought back, in order to check speculation, which is not unfrequent. I did not observe this precaution taken at Canton. Besides the men who were thus employed, there were many others busily at work, passing the tea through various sized sieves, in order to get out the *caper*, and to separate the various kinds. This was also partly done by a winnowing machine, similar in construction to that used by our farmers in England. Having taken a passing glance at all these objects on entering the building, I next directed my attention to the scenting process, which had been the main object of my visit, and which I shall now endeavor to describe.

“In a corner of the building there lay a large heap of orange flowers, which filled the air with the most delicious perfume. A man was engaged in sifting them, to get out the stamens and other smaller portions of the flower. This process was necessary, in order that the flowers might be readily sifted out of the tea after the scenting had been accomplished. The orange flowers being fully expanded, the large petals were easily separated from the stamens and smaller ones. In 100 parts, 70 per cent. were used and 30 thrown away. When the orange is used, its flowers must be fully expanded, in order to bring out the scent; but flowers of jasmine may be used in the bud, as they will expand and emit their fragrance during the time they are mixed with the tea. When the flowers had been sifted over in the manner described they were ready for use. In the meantime the tea to be scented had been carefully manipulated, and appeared perfectly dried and finished. At this stage of the process it is worthy of observing, that while the tea was perfectly *dry* the orange flowers were *just as they had been gathered from the trees*. Large quantities of the tea had now been mixed up with the flowers, in the proportion of 40lbs. of flowers to 100lbs. of tea. This *dry* tea and the *undried* flowers were allowed to lie mixed together for the space of twenty-four hours. At the end of this time the flowers were sifted out of the tea, and by the repeated sifting and winnowing processes which the tea had afterwards

to undergo they were nearly all got rid of. Sometimes a few stray ones are left in the tea, and may be detected even after it arrives in England. A small portion of the tea adheres to the moist flowers when they are sifted out, and this is generally given away to the poor, who pick it out with the hand.

"The flowers, at this part of the process, had impregnated the leaves with a large portion of their peculiar odor, but they had also left behind them a certain portion of moisture, which it was necessary to expel. This was done by placing the tea once more over slow charcoal fires, in baskets and sieves prepared for the purpose of drying. The scent communicated by the flowers is very slight for some time, but like the fragrance peculiar to the tea-leaf itself, comes out after being packed for a week or two. Sometimes this scenting process is repeated, when the odor is not considered sufficiently strong; and the head man in the factory informed me that he sometimes scented twice with orange flowers, and once with the 'Mo-le'—*Jasminum Sambac*.

"The flowers of various plants are used in scenting by the Chinese, some of which are considered better than others, and some can be had at seasons when others are not procurable. I considered it of some importance to the elucidation of this subject, to find out not only the Chinese names of these various plants, but also by examining the plants themselves, to be able to give each the name by which it is known to scientific men in all parts of the world. The following list was prepared with great care, and may be fully relied upon. The numbers prefixed express the relative value of each kind in the eyes of the Chinese, and the asterisks point out those which are mostly used for scenting teas for the foreign markets :—

1. Rose, scented (Tsing moi-qui hwa).
- 1 or 2. Plum, double (Moi hwa).
- 2*. *Jasminum Sambac* (Mo-le hwa).
- 2 or 3*. *Jasminum paniculatum* (Sieu-hing-hwa).
- 4*. *Aglaia odorata* (Lan-hwa, or Yu-chu-lan).
5. *Olea fragrans* (Kwei hwa).
- 6*. Orange (Chang hwa).
- 7*. *Gardenia florida* (Pak-sema hwa).

It has been frequently stated that the *Chloranthus* is largely used. This appears to be a mistake, originating, no doubt, in the similarity of its Chinese name to that of *Aglaia odorata*. The *Chloranthus* is called 'Chu-lan;' the *Aglaia* 'Lan' or 'Yu-chu-lan.'

"The different flowers which I have just named, are not all used in the same proportions. Thus of orange flowers there are 40lbs. to 100lbs. of tea; of *Aglaia* there are 100lbs. to 100lbs.; and of *Jasminum Sambac* there are 50lbs. to 100lbs. The flowers of the Sieu-hing (*Jasminum paniculatum*) are generally mixed with those of the Mo-le (*Jasminum Sambac*) in the proportion of 10lbs. of the former to 30lbs. of the latter, and the 40lbs. thus produced are sufficient for 100lbs. of tea. The 'Qui-hwa' (*Olea fragrans*) is used chiefly in the northern districts as a scent for a rare and expensive kind of Hyson Pekoe,—a

tea which forms a most delicious and refreshing beverage when taken *à la Chinoise*, without sugar and milk. The quantity of flowers used seemed to me to be very large; and I made particular inquiries, as to whether the teas that are scented were mixed up with large quantities of unscented kinds. The Chinese unhesitatingly affirmed that such was not the case, but notwithstanding their assertions, I confess I have some doubt on this point.

"The length of time which teas thus scented retain the scent, is most remarkable. It varies, however, with the different sorts. Thus, the *Olea fragrans* tea will only keep well for one year; at the end of two years it has either become scentless, or has a peculiar oily odor which is disagreeable. Teas scented with orange blossoms and with those of the Mo-le, will keep well for two or three years, and the Sieu-hing kinds for three or four years. The *Aglaiia* retains the scent longer than any, and is said to preserve well for five or six years. The tea scented with the Sieu-hing is said to be most esteemed by foreigners, although it is put down as second or third rate by the Chinese.

"Scented teas for the foreign markets are nearly all made in Canton, and are known to merchants by the names of 'Scented Orange Pekoe,' and 'Scented Caper.' They are grown in and near a place called Tai-shan, in the Canton Province. Mr. Walkinshaw informs me, that other descriptions of tea, both black and green, have been scented for the English market, but have been found unsuitable. True 'caper' is to black tea what the kinds called 'imperial' and 'gunpowder' are to green: it assumes a round, shot-looking form during the process of manipulation, and it is easily separated from the other leaves by sifting or by the winnowing machine. It is a common error to suppose that 'imperial' or 'gunpowder' amongst green teas, or 'caper' amongst black ones, is prepared by rolling each leaf singly by the hand. Such a method of manipulation would make them much more expensive than they are. One gathering of tea is said to yield 70 per cent. of orange pekoe, 25 of souchong, and 5 of caper. The quantity of true caper would therefore appear to be very small; but there are many ways of increasing the quantity by peculiar modes of manipulation.

"In a large factory, such as this at Canton, there is, of course, a considerable quantity of dust and refuse tea remaining after the orange pekoe, caper, and souchong have been sifted out of it. This is sold in the country to the natives at a low price, and no doubt is often made up with paste and other ingredients into those *lie teas* which now-a-days find a market in England. Nothing is lost or thrown away in China. The stalks and yellow leaves which have been picked out by women and children are sold in the country; while the flowers which have done their duty in the scenting process are given to the poor, who pick out the few remaining tea leaves which had been left by the sieve or winnowing machine. Some flowers, such as those of the *Aglaiia* for example, after being sifted out from the tea, are dried and used in the manufacture of the fragrant 'jos stick,' so much used in the religious ceremonies of the country.

"It appears from these investigations that many kinds of fragrant flowers, besides those used by the Chinese, would answer the purpose equally well, and therefore in places like India, where tea is likely to be produced upon an extensive scale, experiments in scenting might be made with any kinds of jasmines, daphnes, aurantiaceous or other fragrant plants indigenous to the country. R. F."

Shanghai, May 2.

Pharmaceutical Journal.

PROCEEDINGS OF SOCIETIES.

BRISTOL MICROSCOPIC SOCIETY.

JUNE 13TH.—Dr. Robert Bartley read a paper "On the *Filaria Medinensis*, or Guinea Worm."

The author stated that the specimens which he had had the opportunity of examining were obtained in the dried state from a gentleman who had been under his care during the summer of 1853, for chronic hepatic disease, and who had a short time previously returned, after a residence of seven years, from Acra in the bights of Benin. The gentleman in question had removed them from his own person by the process usually adopted by the natives, who are particularly liable to be attacked by the worm. As the worms at first presented the appearance of long shreds of catgut, and had been moreover simply preserved in a paper envelope, but little scientific interest seemed at first to be attached to them. They were, however, immersed in spirit, and after some weeks, were removed for microscopic examination. They had by this time swelled out, and had assumed the cylindrical form, being about the thickness of a thin wax vesta. The external skin or envelope was perfectly transparent, and transversely striated; on pressing it, a pellet of white sebaceous-looking matter was extruded, covered by a thickish envelope, which the author believed to be muscular fibre. The pellet, on being broken down with a needle, and placed between slips of glass with a drop of water, under a quarter-inch lens, presented itself as a compact mass of organised beings, or wormlets, varying somewhat in size, and measuring from the 1-40th to the 1-50th of an inch in length, and about 1-1000th of an inch in their largest diameter. These wormlets were mostly cylindrical, some however appeared flattened like tape-worms. At least two-thirds of their body was of equal size, the oval end being slightly rounded, and a distinct oval aperture was visible; the other end terminated in a long, finely-pointed tail, to which the body, from the end of the middle third, gradually tapered. The muscular envelope appeared to answer the purpose of an intestinal canal, besides forming a part of the locomotive apparatus of the animal.

Having failed to find in any work which he had consulted, any account of the internal structure of this animal, the author imagined that, from the few opportunities of examining it presented to the

scientific observer, the presence of these wormlets had been overlooked. He had, however, recently met with a very accurate description of them, in the third volume of "The Annales du Muséum d'Histoire Naturelle," in a letter from M. Jacobson, of the Academy of Sciences at Copenhagen, to M. de Blainville, and dated Feb. 10th, 1834. M. Jacobson had figured these animals (the wormlets) with two mamelons or nipples, situated at the junction of the middle, with the posterior, third of the animal. Dr. Bartley, however, had failed to discover any such in the specimens which he had examined, and considered that M. Jacobson had been led into error in his earnestness to establish their viviparous origin. In the letter referred to, M. Jacobson gives an extract from Rudolphi, who had evidently, so far back as the year 1819 (when his "Entozoorun Synopsis" was published), been struck by the remarkable appearance of these wormlets. The extract is to be found at page 206, *et seq.*, of this work. Dr. Bartley confessed his inability to offer any explanation as to their origin, the subject having puzzled even Rudolphi himself. He, however, suggested whether the excessive irritation produced by breaking the worm in the process of extraction might not arise from the movements of these myriads of living beings (the wormlets) over the already inflamed sore through which the *Filaria* had exit.

Specimens of the several objects referred to in this paper were then exhibited under the microscope.

JULY 11TH.—Mr. W. J. Fedden read a paper "On the Structure of Egg-shells."

After apologising for not having prepared the subject so fully as he could have wished, from the want of more time at his disposal, the author stated, that he intended to confine his remarks strictly to the shell of the egg when freed from the internal lining membrane. He then quoted from an article by Dr. Allen Thompson, in the "Cyclopædia of Anatomy," descriptive of the structure of the egg-shell and its mode of formation, and observed that after the graphic account given, many persons would conceive that nothing more could be said on the subject, but we sometimes try to amuse ourselves by endeavoring to pick holes in other people's coats, and in this unfortunately we may often succeed.

In the article above mentioned, Dr. Thompson says, that the calcareous earthy particles of the shell present in their arrangement a crystalline appearance, but are probably of a different nature. Mr. Fedden observed, however, that the specimens of egg-shells which he had prepared and then exhibited—*e. g.*, those of the murre, the Guinea fowl, and the swan,—presented such forms in their structure that he could not doubt of their true crystalline nature; and in many others a homogeneous crystalline structure was indicated by the polariscope.

Again, Dr. Thompson says, that the substance of the shell is porous, like concretioned gypsum plaster, thus allowing evaporation and transpiration to take place. But the author had found the shell to present generally a much denser structure than is here indicated, and, as has been before observed, interstitial spaces sometimes occur, in which

granular crystals are met with. He believed, however, that there existed true ventilating pores or stomatic openings; indeed minute apertures might be readily perceived in some of the smaller eggs, as, for instance, in those of the water-wagtail, even without reducing the thickness of the shell. The distribution of these ventilating pores appears to be very irregular; and they are generally definite apertures more or less approaching the oval or circular form. In the jack-daw, however, they are cruciform and lunated. They vary in size also in different species. In the case of the Guinea-hen they are round or oval, and more or less irregular, having a diameter of about $\cdot 0008$ to $\cdot 012$ of an inch; in the swan, mostly oval, long diameter about $\cdot 012$ to $\cdot 0016$ of an inch; in the guillemot mostly circular, but occasionally oval, diameter $\cdot 0004$ to about $\cdot 0012$ of an inch; and in the common fowl, irregularly circular, diameter about $\cdot 0008$ to $\cdot 0009$ of an inch. All these measurements were made with *reduced* shells.

According to Thompson, the pigment, where shells are colored, is deposited in cells. Mr. Fedden remarked, however, that he had not yet met with an instance where such was the case. The coloring matter is generally "daubed," so to speak, over the surface, or occurs, interstratified, as it were, in the substance of the shell. Frequently it is merely a uniform fringe of the outermost layer of calcareous matter.

The structure generally to be found in egg-shells the author conceives to be as follows:—The external surface sometimes presents a roughish and imperfect crystalline appearance; but frequently it is smooth and enamelled, as if the outer layer of calcareous matter had assumed a denser crystalline condition; then beneath is a homogeneous and more opaque stratum; whilst the internal surface presents a very curious and interesting structure of a cellular appearance, forming, when the thin section is prepared, an object of much beauty. These cells appear to be caused by the form of the animal tissue, of which the matrix of the shell consists. They are filled with calcareous matter which assumes various forms, such as triangularly formed (tetrahedral?) crystals, stellate crystals radiating from a centre, also needle-shaped crystals, and granular matter. This cellular matrix appears to exist only on the internal surface, and does not extend, so far as the author can ascertain, through the substance of the shell.

AUGUST 8TH.—A paper was read by Mr. Thornton J. Herapath, "On the application of the Microscope to the Identification and Discovery of certain Vegetable Poisons," being the continuation of a communication which was brought before the Society by the author's father, Mr. William Herapath, on May 9th, ult.

After briefly alluding to the importance of toxicology in its relations to medical jurisprudence, the author proceeded to quote a few passages from the works of Paris and Salverte. In the dark ages of modern Europe, he said, the decision of the most important questions was abandoned to chance or to fraud, and the guilt or innocence of the accused was then determined by compelling him to carry in the hand a piece of red hot iron, to walk over red hot ploughshares, to

plunge the arm into boiling water, or to enter into combat with the accuser, and thus a painful and fraudulent experiment supplanting a righteous award, might have consigned to punishment the most innocent, or saved from it the most criminal of men. The trial by ordeal, though long abolished amongst European nations, is still, however, according to Dapper and other travellers, resorted to among the Oojas and numbers of other African tribes. But at the present day, in this country, not only must evidence of the possession of, or access to the poison be afforded, but the accused party must also be proved to have either directly or indirectly administered the poison to the sufferer, and in most cases the law also expects that the poison itself shall be detected in the body, or in the evacuations of the stomach or intestines.

The detection of most of the inorganic poisons, such as arsenic, corrosive sublimate, the salts of copper and lead, &c., Mr. Herapath went on to observe, is now accomplished without much difficulty, except in those cases where only a minute quantity of the poison is present; but in the discovery of the vegetable poisons, it is only by employing his utmost skill, and adopting every imaginable precaution to guard against error, that the judicial chemist can arrive at a satisfactory result. Some of the vegetable alkaloids, indeed, are so virulently poisonous that only five or six one-hundredths of a grain by weight of them—a quantity actually imponderable by an ordinary balance—will suffice to destroy a full-grown man; and it is to be regretted that, for some of the most powerful of these poisons, the chemist does not as yet even possess any distinctive tests. In examining the contents of the stomach or intestines of a person or animal that is suspected to have been poisoned, the toxicologist should first proceed to separate the undigested matters from the more fluid portion. This is usually effected by straining the matters operated upon through a piece of fine muslin or a platinum sieve; and by washing what remains upon the latter with a little pure distilled water. The fluid which has passed through the strainer is then introduced into a closely stoppered bottle, and allowed to remain undisturbed for a short time, in order that any fine solid particles which may be held in suspension may subside. If the poison that has been used is either the powdered nux vomica of the shops, or the powder or raspings of the St. Ignatius bean (*Ignatia amara*), it will be often detected in the deposit, and may be readily recognised by a microscopic examination. The nux vomica powder of the shops is made up, in a great measure, of fine broken agglutinated hairs, and hard cellular masses, which are very peculiar, and colorable yellow by a weak solution of iodine. The powder of the *Ignatia amara*, on the contrary, contains no hairs, but consists entirely of beautifully regular hexagonal cells. Both of the powders, however, assume a dull red tint on treatment with nitric acid, and when this operation is performed under the microscope, each little particle, on coming into contact with the acid, becomes surrounded, so to speak, with a dull reddish halo, and itself assumes a pale reddish-yellow color. This reaction often

takes place even after the powder has been for several hours in the stomach, and was lately observed by Mr. W. Herapath in the case of some dogs which had been poisoned by the powder of nux-vomica, even five or six days after the death of the animals. The author has also frequently succeeded in detecting in this manner particles of nux-vomica powder in his own excrement after taking a large dose of the drug. He has noticed, however, that in most instances where the death of animals has been occasioned by nux-vomica, the powder remains strongly attached to the mucous surface of the stomach and intestines, and may thus be easily purified and detected by its microscopic and microchemical characters. The adherence of the powder to the mucous surfaces has been before noticed by Professor Taylor. (Taylor on Poisons, p. 775.)

After examining the deposited matters in the manner just described, the analyst should next proceed to submit a portion of the fluid contained in the bottle to a slow distillation in a tubulated retort. This operation is best conducted in a water or saline bath. Should any Prussic acid, oil of bitter almonds, or oil of savin be present, they will distil over and be found in the distillate, and may often be recognised by their peculiar odor. The same observations may be made with respect to the essential oil of the yew and croton oil. When only a small quantity of hydrocyanic acid is present, it is best detected by Liebig's test. The distillate should be mixed with a few drops of a solution of pentasulphide of ammonium, and carefully evaporated to dryness; the fixed residue should then be acted upon by a drop or two of water, and the clear solution should be cautiously evaporated on the surface of a Stanhope lens, and tested with a weak and almost colorless solution of the perchloride or peracetate of iron. A red coloration is indicative of sulphocyanic acid, formed by the action of the sulphide of ammonium on the hydrocyanic acid. It is sometimes advisable to add a slight excess of sulphuric acid to the liquid contained in the retort prior to distillation.

Having proved the absence of all the poisons before alluded to, the operator should next add an excess of magnesia or caustic alkali to the same or to another portion of the fluid, and repeat the operation of distillation. If the fluid contains any volatile alkaloid, it will be set free by these reagents, and will distil over. A small quantity of ammonia will also be generally contained in the distillate. By agitating the latter with a little chloroform, in the manner that has been described by Mr. Herapath in a paper, "On the Presence of Nicotine in the Urine of Tobacco Smokers" (*Vide*, THE CHEMIST, N.S., vol. ii., p. 522), the alkaloid may be separated from its aqueous solution, and from the ammonia by which it is accompanied, and by spontaneous evaporation may be obtained in a nearly pure state. By this process we may detect nicotine (the poisonous principle of tobacco), coniine or conicine (of hemlock, *Conium maculatum*), secaline (of ergot of rye), hyoscyamine [?] (of henbane, *hyoscyamus niger*), and sparteine (of the broom, *Spartium scoparium*, and most probably of the laburnum, *Cytisus Laburnum*). It must be borne in mind, however, that secaline,

or an alkaloid (trimethylamine or propylamine) closely resembling that principle, is likewise contained in the liquid of pickled herrings. Several of these volatile alkaloids may be distinguished by their odor, which is rendered much more manifest on the application of a gentle heat. The odor of nicotine resembles that of tobacco; secaline, that of pickled herrings; coniine and hyoscyamine, that of mice's urine. Coniine, according to Orfila, may be distinguished from nicotine, by dissolving without alteration in cold concentrated sulphuric acid, by its acquiring a pure topaz color on treatment with nitric acid, and by not being precipitated by the neutral acetate of lead (*Chem. Gaz.*, 1852, vol. x., p. 189). The behavior of secaline, hyoscyamine, and sparteine with reagents has not been thoroughly investigated, but much useful information with respect to them may be gained by consulting the papers by Winckler and Stenhouse, which have been published in the *Annals of Pharmacy* (vol. ii., pp. 21 and 77), and in the *Quarterly Journal of the Chemical Society* (vol. iv., p. 216).

Should no volatile alkaloid be detected, the experimentalist should evaporate the contents of the retort, or a fresh portion of the liquid, previously mixed with caustic magnesia, to dryness in a water-bath, and act upon the residue with boiling alcohol. If any fixed (*i.e.*, non-volatile) alkaloid is contained in the matters submitted to analysis, it will be dissolved out by the alcohol, and on evaporating the latter will be obtained in a comparatively pure state, but still mixed with a little fat, osmazome, &c. On acting upon this mixture with a small quantity of water acidulated with sulphuric or hydrochloric acid, the fatty matters will be left undissolved, and by mixing the acid solution with a slight excess of alkali, and agitating it with chloroform, ether, or pure fusel-oil, the alkaloid may be purified from osmazome, &c., and obtained in a fit state for the application of chemical tests. From the experiments of Mr. John Williams (*vide*, THE CHEMIST, N.S., vol. i., p. 122) it would appear that benzole may be also resorted to with advantage in the separation of the alkaloids, though Mr. Herapat observed that he preferred employing chloroform in those cases where the alkaloid is soluble in that menstruum. A reference to the table of Chemical Solubility and Insolubility, published in the second volume of this work, will enable the analyst to determine which solvent he should have recourse to in special cases. Chloroform, it will be observed (*Vide* THE CHEMIST, vol. ii., p. 137), may be used for the detection of strychnine and brucine (the active principles of *nuxvomica*, St. Ignatius' bean, &c.), aconitine (of the monk's-hood, *Aconitum*), atropine (of the deadly nightshade, *Atropa belladonna*, and thorn-apple, *Datura stramonium*), veratrine (of white hellebore, *V. album*, &c.), colchicine (of the root and seed of the meadow saffron, *Colchicum autumnale*), narcotine (of opium), and ematine (of ipecacuanha). It also dissolves quinine and piperine, alkaloids which are occasionally used in medicine, and which consequently may be found by the analyst in the contents of a stomach, and embarrass him by their presence. Morphine, picrotoxine (the active ingredients of *Coccolus Indicus*), digitaline (of the foxglove, *Digitalis purpurea*), Salicine, and

Cinchonine, are, however, but sparingly soluble, or almost insoluble in this liquid, and must, therefore, be separated by some other solvent. Fusel oil, it has been stated, dissolves nearly all the alkaloids. In some instances, Mr. Herapath observed, animal charcoal may be employed to separate the vegetable principle from other matters with which it may be contaminated, and he had frequently employed it, for instance, in the detection of picrotoxia (*Vide* a paper "On the Adulteration of Malt Liquors with *Coccolus Indicus*," THE CHEMIST, N.S., vol. i., p. 577 *et seq.*). He thought it right to state, however, that the employment of animal charcoal in medico-legal investigations was first suggested by Messrs. Graham and Hofman, who, by its means, were enabled to demonstrate the absence of strychnine in pale ale. The alkaloid having been separated, then, by one of these processes, should be next tested with certain chemical reagents. Attention should also be paid to its crystalline form, and to that of its salts. Certain alkaloids, such as morphine, strychnine, &c., crystallise readily, whereas others, namely, aconitine, veratrine, &c., can only be obtained in the amorphous condition. As it frequently happens that the whole amount of vegeto-alkali which is extracted by the chemist does not exceed one or two one-hundredths of a grain, it is hardly necessary to observe, that great care must be taken in applying the tests, otherwise the whole of the poison will be consumed in one operation. It is here that the microscope is found of great service by the experienced toxicologist, as it often enables him to apply at least twenty different tests, where, without its aid, he could hardly apply one. A simple Stanhope lens, and a fine glass rod about the one-twentieth of an inch in diameter, are usually all the apparatus that is required; but in testing for some vegetable alkalies, a compound microscope of moderately high power is necessary. In applying the reagents to the substance to be tested, they should not be added at once to the solution of the alkaloid, but one or two minute drops of the latter should be transferred to the surface of the Stanhope lens, or to a plate of glass, and evaporated to dryness; a drop of the reagent should then be placed near to it, and by proper management should be caused to come into contact with the evaporated matters. The only fixed alkaloids for which we are acquainted with distinctive tests, are strychnine, brucine, morphine, narcotine, papaverine, digitaline, scillitine, veratrine, *santonine*, *salicine*, *quinine*, and, perhaps, *cinchonine*.

Strychnine may be best detected in the following manner:—One or two drops of the solution supposed to contain this alkaloid should be evaporated on the surface of a Stanhope lens, and the fixed residue should be dissolved in a small drop of concentrated sulphuric acid, to which about the one five hundredth part of nitric acid has been added. A minute particle of bichromate of potash (Otto's test), peroxide of lead (Marchand's modification), or ferridcyanide of potassium (E. W. Davy's modification), should then be dropped into the acid solution, when, if any strychnine is present, a fine but evanescent purple coloration will be observed immediately surrounding the solid

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particle. (For an account of the behavior of this test with other vegeto-alkali, *vide* a paper, by M. Eboli, in *THE CHEMIST*, vol i., N.S., p. 551.)

Brucine differs from strychnine in yielding a deep red solution on treatment with nitric acid. A somewhat similar coloration, however, is also produced by morphine and two or three other alkaloids. Morphine acquires a deep red color; veratrine, a light red; delphinine, an iron-rust red; and narcotine, a dingy reddish-yellow color when tested with this reagent (Taylor). The coloration, in the case of brucine, changes to violet, and is subsequently discharged, on the addition of a little protochloride of tin. Alluding to this property of brucine, Dr. Taylor observes, "I have, however, found it to be produced in all the specimens of uncombined strychnia which I have tried; and it is pretty certain that no specimen of strychnia is likely to come before a medical jurist in practice, which does not possess the property of turning red with nitric acid." In all cases of poisoning by nux-vomica, commercial strychnine, &c., therefore, when the alkaloïd is extracted by means of alcohol and chloroform, the impure strychnine obtained invariably assumes a red color on being tested by nitric acid; this reaction may consequently be almost considered as a test for strychnine.

Morphine produces an inky-blue color when tested with a solution of the sesqui-chloride of iron; and when added to a weak solution of iodic acid holding a few starch granules in suspension, the latter are colored blue in consequence of the formation of the so-called iodide of amidine.

Narcotine, when dissolved in strong sulphuric acid, and tested with a small particle of nitrate of potash, yields a beautiful crimson-colored solution.

Papaverine turns blue when moistened with concentrated sulphuric acid.

Digitaline and scillitine produce a very beautiful but fugitive purple color with the same reagent (Labordais' test).

Salicine assumes a pink color on being moistened with oil of vitriol; and when distilled with a mixture of sulphuric acid and bichromate of potash, is converted into salicylous acid, which may be distinguished by its odor; with sesqui-chloride of iron it yields a fine violet solution (Wöhler).

Veratrine gives a light red, turning to an ochreous color, with nitric acid; and with sulphuric acid, an intense orange-brown color, which becomes of a deep claret-red on the addition of chromate of potash (Taylor).

Santonine dissolves in caustic alkalis with a fine carmine color (Heldt).

Quinine, when it is dissolved in a few drops of warm acetic acid containing a minute proportion of sulphuric acid, and the resulting solution is mixed with a drop or two of weak alco-

holic solution of iodine, yields, on cooling, minute green crystals, which strongly polarise light (Herapath's test). When it is dissolved in chlorine water, and the solution is subsequently mixed with a little *liq. ammonia*, a fine green coloration is produced (Mengarduque); when ferrocyanide of potassium is substituted for the ammonia, a dark-red coloration results, and with a solution of potassa, a sulphur-yellow (Vogel).

In order to distinguish the other vegeto-alkalis, Mr. Herapath observed, we must have resort to compound testing. The reagents usually employed for this purpose are chloride of gold, bichloride of mercury, sulphocyanide of potassium, protochloride of palladium, bichloride of iridium, carbazotic acid, and a solution of bicarbonate of potash, followed by an excess of tartaric acid (*vide* Gmelin's *Handbook of Chemistry*, English translation, vol. viii., p. 184; also papers by Lepage, Larocque, and Thibierge, and Opperman's in the *Chemical Gazette*, vol. i., p. 94; vol. ii., p. 404; and vol. iii., p. 478). The author believes, however, that croconic acid and chrysammic acid will be also found extremely serviceable, and he is now engaged in working out the subject.

The dilation of the pupil of the eye, Mr. Herapath stated, is one of the best tests for some of the poisonous alkaloïds. A single drop of a solution made by dissolving one grain of atropine or aconitine in a drachm of water when placed in the conjunctiva, causes a sensible effect in from five to fifteen minutes. In applying this test, however, to the detection of these substances, the precaution should be taken to employ pure aqueous or weak alcoholic solutions of the alkaloïds, otherwise severe inflammation of the eye may be produced. Digitaline, coniine, and hyoscyamine also produce dilatation of the pupil, though not in so marked a degree as atropine and aconitine.

The author then proceeded to point out the corroborative evidence that was often afforded by examining the portions of undigested food which may be separated from the fluid contents of the stomach by means of a sieve or muslin strainer; and called attention to the use of the microscope in recognising certain poisonous vegetables by the form of the hairs, the state of the stomach, and of the cells of the epidermis, of the leaf and fruit, and of the integuments, &c., of the seeds. Animals, particularly poultry, are frequently poisoned accidentally by eating poisonous plants and seeds. And cases are occasionally brought before the notice of toxicologists where human beings have been destroyed by eating unwholesome roots and fruits; as, for instance, the roots of *Aconitum* and of *Ænanthe crocata*, the fruit of *Atropa belladonna*, &c. Most of the vegetable poisons are so rapid in their action, that it seldom occurs that the whole of the poisonous vegetable has time to undergo digestion in the alimentary canal, and, consequently, by carefully separating the remains of the undigested food, and then examining them first by a pocket lens, and afterwards by a powerful microscope, the toxicologist will often succeed in determining the nature of the poisonous vegetable which has been the cause of death, even should only minute fragments of it be obtainable. In the exami-

nation of the leaves of plants, the operator should pay particular attention to the nervation and venation, the margin of the leaf, the shape of the point or apex, and the form of the hairs, if such be present. The hairs of some plants, such as those of the N.O. *Scrophularinæ* and *Solanaceæ*, being generally glandular, are easily recognisable, and afford valuable indications.

When portions of what is believed to be the leaves of yew or savin are met with, they should be first examined with a pocket lens, and then crushed in a mortar, and examined by a microscope of high power. The woody fibres of both these plants are furnished with circular pores characteristic of the *Gymnospermæ*, and which are rendered more evident when the pulp is moistened with strong nitric or hydrochloric acid. The leaves of savin and yew may be distinguished from each other, as well as from the other conifers, by the shape of the apex. (*Vide* an interesting report of a case of poisoning by savin, in which the above characters were successfully made use of to detect the poison, by Dr. A. Taylor and Mr. Chas. Johnson, *Lond. Med. Gaz.* for Aug. 8, 1845, p. 646; also *Pareira's Materia Medica*, vol. ii., part 1, p. 1210.)

Many poisonous plants, the author said, may be easily detected from the form of the seed and the structure of the integuments, for although he has lately examined many hundred different seeds of the plants most commonly met with in our fields and gardens, he has seldom met with two plants the seeds of which correspond in both respects; and he is disposed to think that a microchemical examination of the husks or integuments of seeds may often be employed with great advantage by botanists in determining the identity or non-identity of closely allied species. The only plants which cannot be readily distinguished by this means are those belonging to the N.O. *Leguminosæ* and *Graminæ*. It fortunately happens, however, that there are but two poisonous plants, met with in this country, which belong to these classes; namely, the laburnum and the darnel. When poultry have been poisoned by eating these seeds, a few of the latter are generally found in the gizzard in the undigested state, and when dried may be easily recognised. The only graminaceous seed for which darnel is apt to be mistaken, is that of the oat. By crushing the seed, however, and examining the starch granules by the microscope, they may be readily distinguished from each other. The size and form of the pigment cells, &c., are also different. (*Vide* articles on *Avena sativa* and *Lolium temulentum*, in *Pareira's Materia Medica*, vol. ii., part 1, pp. 972 and 976.) When suspicious seeds are met with in the matter subjected to analysis, they should be picked out, washed and dried, and then examined by a lens of low power as opaque objects. They should next be crushed with a mortar, acted upon with a little hot dilute nitric acid (composed of about one part of acid to from four to six parts of water), and then submitted to examination by a lens with a magnifying power of 400 or 500 diameters. By the action of the nitric acid, the integuments or husks of the seeds are rendered semi-transparent, and the form of the markings and of

the constituent cells are easily observed. Mr. Herapath has already pointed out the application of this process to the detection of the adulteration of oil-cake, &c. (see THE CHEMIST, N.S., vol. ii., p. 507), and he now finds that it may be also resorted to with advantage in medico-legal researches. The seeds which may be most readily detected by this method are those of *Atropa belladonna*, *Hyoscyamus niger*, *Datura stramonium*, *Nicotiana tabacum*, *Helleborus niger*, *Papaver somniferum*, *Euphorbia peplus*, *E. Exigua*, *E. helioscopia*, *Lobelia inflata*, *Delphinium staphyriagria*, *Digitalis purpurea*, *Croton tiglium*, *Colchicum autumnale*. In the first three the markings are irregular and sinuate—very large in *Hyoscyamus*, not quite so large, but deeper in *Atropa*, and still deeper and more irregular in *Datura*. The seeds of *hyoscyamus* and *atropa*, however, are small in size, whilst those of *datura* differ from them in shape, and are considerably larger. In *Nicotiana* and *Helleborus* the markings are also sinuate, but very different from those observed in the three former, and considerably smaller. The markings in the other seeds mentioned are entirely different, and cannot be mistaken for them, or for those of any other seeds with which the author is acquainted.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The twenty-fifth Annual Meeting of this Association was held at Glasgow, on Wednesday the 12th September, and following days. The following is a sketch of the chief Chemical Papers read before it.

Dr. ANDERSON delivered a lecture on the action of Acids and Alkalies on Coloring Matters, which he illustrated by experiments. A piece of common boxwood, dipped into a compound of sulphuric and some other acids, changed into a bright purple color; logwood assuming a bright purple. The alkalies of oxygen, hydrogen, nitrogen, with these other ingredients, produced similar results.

Baron LIEBIG handed in for inspection a large bar of the new and interesting metal, Aluminium. After some remarks from the PRESIDENT (Dr. Playfair) respecting the source and some of the remarkable properties of this metal, Dr. DAUBENY mentioned that he had in his possession a set of small analytical weights made from this metal, which is peculiarly adapted to this purpose owing to its great specific lightness.

Dr. PLAYFAIR mentioned an interesting property of the metal aluminium—its resonance, which was evident to the whole Section.

On the CHEMICAL CHANGES undergone by ARTIFICIAL SEA WATER, after ten months' use in the MARINE VIVARIUM.

By G. WILSON, F.R.S.E., Professor of Technology in Edinburgh.

It is stated that M. Gosse, a scientific gentleman, had paid great attention to the artificial production of sea-water. The average of ingredients used by him when making his last successful experiments was

The following:—4½ ounces of fresh water, 3 ounces of common salt, 1 ounce of Epsom salts, 200 grains of chloride of magnesium, and 40 grains of the chloride of potassium. He gave a luminous description of the maintenance of the life and health of fishes in a vivarium; and showed that, at the end of the ten months, the sea-water was as pure as when first used. There was no question of the complete success of the artificial process. An extensive manufacturer in a central part of Prussia, proposes to M. Gosse the constructions of a vivarium at his works, not despairing of the success, although situated at a great distance from the sea, of maintaining inland sea-water in a condition of perfect purity. The difficulty is to get the animals conveyed so far into the country.

The following is an analysis of artificial sea-water:—

	Original Composition.	After ten months' use.	After six months' use
Specific gravity . . .	1026·00	1024·30	1022·30
Chlorine	983·20	1304·80	1255·10
Magnesia	120·90	154·70	144·90
Sulphuric acid	72·80	95·20	91·00
Lime	0·00	58·10	53·90

On the POLAR DECOMPOSITION of WATER by FRICTIONAL and ATMOSPHERIC ELECTRICITY. By PROF. ANDREWS.

THE author having drawn attention to the fact, that water had never been decomposed by the action of the common friction electricity, so as to collect the gases and exhibit them at the opposite poles, stated that the cause of the failure of the experiments was the solution of the gases in the mass of the liquid. By fusing platinum wires in thermometer tubes, this difficulty is avoided, and the gases may be then obtained and collected with the same facility as in ordinary eudiometric experiments. By arranging a series of such tubes, the operations may be almost indefinitely repeated. On raising an electrical kite, the author succeeded in obtaining the polar decomposition of water by atmospheric electricity. The observations were made in fine weather, when the atmosphere was not usually charged with electricity. Although the gases were easily collected and measured, from the delicate form of apparatus employed, the quantity of water decomposed in this case amounted only to one 700,000th of a grain in the hour.

On the METALS of the ALKALINE EARTHS. By DR. MATTHIESSEN.

DR. MATTHIESSEN has succeeded in preparing the metals strontium and calcium, in the form of metallic reguli. The mode of preparation was illustrated by the apparatus used, and beautiful specimens of the metals, sealed up in tubes containing roche oil, and free from all air, were circulated among the members of the Section. Specimens of Lithium wire, prepared by Prof. Bunsen, at whose laboratory at Heidelberg the foregoing metals were prepared, were also exhibited.

On a New Cyanic Acid. By M. LIEBIG.

WHILE making some experiments on fulminate of mercury, I observed that this compound, when kept in ebullition in water, changed its color and lost its fulminating properties.

On examining the changes which had taken place in the composition of the fulminate I discovered a new acid, which had exactly the composition of cyanuric acid, but which differs from this acid in the properties of the salts which it produces with the alkaline bases, salts which are very remarkable for their beauty, and the clearness of their crystalline form.

Admitting as the equivalent of the hydrated fulminic acid, the formula C^2NO , HO, the formation of the new acid admits of explanation in a very simple manner.

The elements of three equivalents of the fulminic acid, are united to form one equivalent of the new acid, which I shall call *fulminuric acid*. This acid is monobasic.

Three equivalents of fulminic acid = $3(C^2NO^2H)$ form one equivalent of fulminuric acid = $C^6N^3O^6H^3$.

The formula of the salt of potassa is	$C^6N^3O^6H,$	}	
	K		
„ „ baryta	$C^6N^3O^6H^2$	}	+ 2Aq.
	Ba		
„ basic salt of lead	$C^6N^3O^6H^2$	}	+ PbO.
	Pb		
„ of the salt of ammonium	$C^6N^3O^6H^2$	}	
	NH ⁴		
„ „ silver	$C^6N^3O^6H^2$	}	
	Ag		

The salt of silver is soluble in hot water; and crystallises in long silky needles.

The fulminurates, with an alkaline base, are very easily prepared with fulminate of mercury, by boiling this compound with an alkaline chloride. The fulminate of mercury first dissolves, then two-thirds of the mercury are precipitated in the state of hydrated oxide of mercury, and the alkaline fulminurate remains in the solution. By using chloride of potassium, sodium or barium, the fulminurate is produced with the corresponding base of potassa, soda or baryta. With chloride of ammonium is obtained the ammonia salt, whose crystals are distinguished from those of the others by their diamond lustre; these crystals belong to the klinorhombic system, and possess a double refraction to almost as great a degree as the Iceland spath. When subjected to a high temperature, they give rise to a slight deflagration.

The hydrated acid is easily obtained by decomposing the basic lead salt with sulphuretted hydrogen. It possesses a powerful acid reaction; when evaporated to a syrupy consistence, it becomes gradually a crystalline mass, which dissolves in alcohol and changes, by the action of the acids, into carbonic acid and ammonia.

On the PHOSPHORESCENCE and COMPOSITION of PLATE SULPHATE of POTASH. By PROF. PENNY.

THE subject of this paper is a chemical product from kelp. It is called plate-sulphate of potash from the circumstance of its being crystallised in thick plates or slabs, consisting of the aggregate layers of successive crops of crystals. Beautiful specimens of the salt, supplied by Mr. Paterson, one of the most extensive manufacturers of kelp products in Glasgow, were exhibited to the Section. There are several points in the chemical history of this salt possessing a high degree of scientific interest. When placed in a temperature of 100° Fahr., the plate emitted, not one continuous flame, but a series of vivid sparks from the crystalline mass. The light, when placed at a temperature above 100° was very feeble, and decreased in brilliancy as the temperature descended. Professor Penny stated that his experiments were yet incomplete, and that his dissertation could not, consequently be very profound. He gave out many valuable hints regarding an easy process of forming the plate, and also explained the many uses to which it could be applied. The composition of plate sulphate was as follows:—

	Experiment.	Theory.
Potash	42·22	42·47
Sulphuric acid	48·24	48·19
Soda	9·54	9·34
	100·	100·

Dr. GLADSTONE made a few remarks on this paper. He stated that Professor Penny and himself had proceeded on the investigation of this subject from different starting points, and yet had arrived at the same results. With reference to the strange light emitted from the plate, he was at a loss to know how it was caused, but remarked it was a phenomenon which bore a strong resemblance to electricity.

Dr. ANDERSON called attention to the name—Plate Sulphate. It was a generally received opinion that it was so designated from the fact, that when being produced, it adhered to the sides of the vat, and formed, as it were, a plate. It was understood, however, among manufacturers, that the real reason for its being so called was its having been first used in the manufacture of plate glass.

Professor PENNY said that manufacturers as well as chemists were at variance in reference to this question.

A short discussion followed, in which Dr. PLAYFAIR, Dr. MILLER, and Professor PENNY took part.

CHEMICAL COMPOSITION of the WATERS of the CLYDE.

Dr. STEVENSON MACADAM, F.R.S.E., F.C.S., Edinburgh, submitted a paper "On the Chemical Composition of the Waters of the Clyde."

This communication was the first of a series which the author has undertaken, in order to determine the chemical composition of the

rivers of Scotland. The examination was confined to the river and
 firth, from Dalmarnock Bridge to Arran. Specimens of the water at
 the more prominent stations were procured by the author and sepa-
 rately analysed. Three points were determined, viz.:—1st. The
 specific gravity; 2nd. The amount of saline water; and 3rd. The
 quantity of the Clyde waters at all seasons; wet or dry weather, and
 the ebbing or flowing of the tide must all tend to affect the results
 given above. This is well seen in the instances of Bowling and Ren-
 frew, where water of a similar composition is found— at Bowling
 during every ebb of the tide, and at Renfrew during flood-tide.

Of chlorine, the following table contains the results of the analyses
 of the various waters:—

Low Water.	Specific gravity.	1000 grains.	
		Saline Matter.	Chloride.
Dalmarnock Bridge	1000·25	0·28	0·02
Rutherglen ditto	1000·28	0·30	0·03
Green Suspension ditto			
Suspension ditto	1000·40	0·45	0·06
Broomielaw	1000·60	0·67	0·10
Lower Quay	1000·60	0·66	0·10
Govan	1000·59	0·64	0·10
Renfrew	1000·62	0·70	0·15
Kilpatrick	1000·92	1·12	0·60
Bowling	1001·33	1·62	0·79
Dumbarton	1002·3	2·92	1·61
Ditto, 1 mile below	1005·8	7·38	4·03
Ditto, 2 miles below	1007·3	9·36	5·18
Port-Glasgow	1011·3	14·42	7·96
Greenock	1021·8	27·87	15·48
Ditto, Helensburgh	1018·9	24·53	13·59
Helensburgh	1020·4	26·02	14·46
Row	1022·1	28·24	15·63
Roseneath	1022·1	28·29	15·64
Shandon	1022·3	28·35	15·82
Rochean	1022·4	28·52	15·91
Gairlochhead	1022·4	28·49	15·91
Greenock—Kilcreggan	1020·2	25·77	14·31
Kilcreggan	1021·9	28·06	15·53
Cove	1021·8	27·84	15·47
Portinstuck	1022·7	28·97	16·09
Lochlong—Lochgoil	1022·8	29·02	16·14
Arrocher	1005·4	6·86	3·78
Strone	1022·4	28·51	15·88
Kilmun	1022·1	28·26	15·62
Sandbank	1021·8	27·85	15·48
Lazaretto	1022·3	28·36	15·80
Gourock	1021·9	27·97	15·52

Low Water.	Specific gravity.	1000 grains.	
		Saline Matter.	Chloride.
Ditto, Kirn	1022.9	29.23	16.31
Kirn	1024.3	31.02	17.23
Dunoon	1024.3	31.06	17.24
Inellan	1023.6	30.12	16.88
Toward Point	1023.3	29.70	16.54
Rothsay	1022.5	28.68	15.97
Ascog	1024.2	30.98	17.16
Kilchallan Bay	1024.4	31.16	17.43
Garrock-head	1024.9	31.72	17.69
Corrie	1026.6	33.98	18.91
Brodick	1026.3	33.66	18.72
Millport	1025.6	32.72	18.34
Fairley	1025.6	32.68	18.23
Largs	1025.4	32.46	18.08
Wemyss Bay	1025.6	32.71	18.25
Innerkip	1024.1	30.83	17.08
High Water.			
Bowling	1006.4	8.14	4.38
Renfrew	1001.6	2.02	1.09

The above figures are not to be taken as expressing the standard composition.

Professor PENNY said the paper was the revival of an old subject. In the year 1848 a large analysis had been made by Mr. Wm. Wallace from Tarbolton to Ailsa Craig, and not only were those qualities given to which Dr. Macadam had made special reference, but an elaborate dissertation was given on each specimen collected. They could be seen in the local papers of 1848.

Professor FRANKLAND, F.R.S., read a paper on some organic compounds containing metals. He made some very beautiful experiments with a composition, being a combination of oxide of zinc and oxide of ether. It was secreted in a closed tube, which, when opened, and the composition exposed to the air, bursts into a flame and evaporates. Attempts had been made to unite the substance with potassium, soda, &c., but in doing so it lost all its properties, and consequently a combination could not be effected. The paper was meant intentionally for learned chemists, as it merely illustrated the more profound principles in this department of science.

Professor ANDREWS read a paper on an "Allotropic Modification of Chlorine and Bromine analogous to the Ozone from Oxygen." He explained that ozone could be produced by any one of the three following processes:—First, it could be obtained by an electric spark; secondly, by the decomposition of acids and solutions, when coming into contact with the galvanic wire; and, lastly, by oxidation. This was a very elaborate paper, and was listened to with much attention.

Dr. PLAYFAIR read a paper by Mrs. Cross, on the "Apparent Mechanical Action accompanying Electrical Transfer." He stated that at the last meeting of the Association, held in Liverpool, Mr. Cross, since dead, had read a paper referring to a phenomenon which took place in electrical currents. It had been objected on that occasion that it was possible the gold that was carried over should have been due to impure gold, and that it was owing to a solution of copper in the gold that this mechanical phenomenon had ensued. Mrs. Cross, desirous of showing the accuracy of her husband's labors, had, after his death, repeated the experiment with pure gold, and obtained the same result. Dr. Playfair, after reading the paper, said he thought it present would admit that Mrs. Cross had taken great pains to verify the experiment of her husband.

On a PROCESS for obtaining LITHOGRAPHS by the PHOTOGRAPHIC PROCESS. By PROFESSOR RAMSEY.

PROFESSOR RAMSEY described a process by which Mr. R. M'Pherson, of Rome, had succeeded in obtaining beautiful photo-lithographs,—specimens of which had been hung up in the Photographic Exhibition in Buchanan-street. The steps of the process are as follows :—

1. Bitumen is dissolved in sulphuric acid, and the solution is poured on an ordinary lithographic stone. The ether quickly evaporates, and leaves a thin coating of bitumen spread uniformly over the stone. This coating is sensitive to light, a discovery made originally by M. Niepce, of Chalons.
2. A negative on glass, or waxed paper, is applied to the sensitive coating of bitumen, and exposed to the full rays of the sun for a period, longer or shorter, according to the intensity of the light, and a faint impression on the bitumen is thus obtained.
3. The stone is now placed in a bath of sulphuric ether, which almost instantaneously dissolves the bitumen, which has not been acted upon by light, leaving a delicate picture on the stone, composed of bitumen on which the light has fallen.
4. The stone, after being carefully washed, may be at once placed in the hands of the lithographer, who is to treat it in the ordinary manner with gum and acid, after which proofs may be thrown off by the usual process.

Professor RAMSEY then proceeded to state that the above process, modified, had been employed with success to etch plates of steel or copper, without the use of the burin :—

1. The metal plate is prepared with a coating of bitumen, precisely in the manner noticed above.
2. A positive picture on glass or paper is then applied to the bitumen, and an impression is obtained by exposure to light.
3. The plate is placed in a bath of ether, and the bitumen, not acted upon by light is dissolved out. A beautiful negative remains on the plate. The plate is now to be plunged into a galvano-plastic bath, and gilded. The gold adheres to the bare metal that refuses to attach itself to the bitumen.
5. The bitumen is now removed entirely by the action of spirits and gentle heat. The lines

of the negative picture are now represented in bare steel or copper, the rest of the plate being covered by a coating of gold. 6. Nitric acid is now applied as in the common etching process. The acid attacks the lines of the picture formed by the bare metal, but will not bite into the gilded surface. A perfect etching is thus obtained.

*On the COMPOSITION of TWO MINERAL SUBSTANCES EMPLOYED as
PIGMENTS.*

Dr. THOS. H. ROWNEY submitted a communication, in which he gave a description of two mineral substances, which are employed as pigments. Indian Red is brought from the Persian Gulf. It occurs in the form of a coarse powder, of a deep red color; its sp. gr. is 3.843. Raw sienna is obtained from Sienna. It occurs in soft lumps, of a brownish yellow color, which have a conchoidal fracture; its sp. gr. is 3.46.

On the COMPOSITION of VANDYKE BROWN.

Dr. ROWNEY likewise read a paper giving a description of a peculiar organic coloring matter obtained from a peat earth near Cassel, in Germany. It occurs as a soft earthy looking substance, of a deep brown color, and a little heavier than water. It burns when heated, and leaves about 6.00 of ash.

BIBLIOGRAPHY.

THE COMMERCIAL HAND-BOOK OF CHEMICAL ANALYSIS, OR PRACTICAL INSTRUCTIONS FOR THE DETERMINATION OF THE INTRINSIC OR COMMERCIAL VALUE OF SUBSTANCES USED IN MANUFACTURES, IN TRADES AND IN THE ARTS. By A. NORMANDY, Author of "Practical Instructions to Rose's Chemistry," and Editor of Rose's "Treatise of Chemical Analysis." London: George Knight and Sons, Foster Lane, Cheapside—pp. 640.

THIS is an exceedingly useful book, and it is written in a clear and practical manner. The author well describes the form or physical appearance of the numerous articles of commerce, and gives many simple and useful processes for ascertaining whether an article be pure or sophisticated. We recommend the "Hand-Book" to our readers, as a book of considerable merit. Druggists, drysalters, and merchants will find it invaluable to them.

BOOKS RECEIVED.

THE UNITY OF MATTER. A Dialogue on the Relation between the various forms of matter which affect the Senses. By ALEX. STEPHEN WILSON.

THE FARMER'S MANUAL OF AGRICULTURAL CHEMISTRY, with Instructions respecting the Diseases of Cereals, and the Destruction of the Insects which are injurious to those Plants. By A. NORMANDY. London: George Knight and Sons, Foster Lane, Cheapside.

THE CHEMIST.

ORIGINAL COMMUNICATIONS.

A NEW METHOD *of* TESTING *for and* MANUFACTURING IODINE.*

By Mr. JOHN HORSLEY, of Cheltenham.

In a previous paper I mentioned some experiments I had made with chromate of potash, as a test for the detection of coffee, in adulterations or mixtures of coffee and chicory, as also a modification of the same for cane and grape sugar.

In following up these experiments I applied the same salt to the detection of the iodine of the alkaline iodides, when a circumstance occurred, which I had never seen recorded in any chemical work, viz. the complete precipitation of the iodine in a pure and crystalline form. On investigating the matter, I found that for every equivalent of iodine so precipitated, it required an equivalent of the chromic salt with the addition of free acid. For instance, dissolve twelve grains of iodide of potassium together with eight grains of the bichromate of potassa in one ounce of water, and mix with it sixteen grains of oxalic acid dissolved in another ounce of water—agitate the two solutions well for a minute or two, with a glass rod; the iodine will be thrown down as stated, leaving but a mere trace of iodine in the solution. Sulphuric or hydrochloric acid would answer equally well; I merely mention the oxalic acid as being that which I at first used.

The rationale of its action is easily explained.

The iodine of the iodide is first converted into hydriodic acid, which becoming subsequently decomposed by the abstraction of its hydrogen to form water, causes the iodine to be completely precipitated in a pure state, i.e. if due proportion of materials have been used; should however little or no precipitation occur while the liquid assumes a dark brown or red color smelling strongly of iodine, it is proof that either the chromate or the acid used is deficient in quantity.

The use of a chromic salt, in the manner suggested, furnishes us not only with an invaluable test of the presence of iodine, but an excellent means of estimating its quantity, from the ease and precision with which it is effected.

I therefore propose the following as a test liquor for laboratory purposes as well as for precipitating iodine on the large scale.

Dissolve one ounce of bichromate of potassa in fifteen ounces of boiling water; when cold, add five fluid ounces of strong sulphuric acid; stir the mixture and let it stand till cold.

Such is the superiority of its action over other tests that, when one

* Read at the recent meeting of the British Association at Glasgow.

grain of iodide of potassium is diffused through eight gallons of water, its iodine is readily recognised by the smell alone, provided a sufficiency of the test liquor has been added; a few grains of starch powder stirred in, becomes tinged of a pinkish or light violet color, which is considerably heightened when a smaller quantity of the diluent is used.

It occurred to me, seeing the readiness with which pure iodine can be thus obtained, that the same might be applied to the manufacture of iodine commercially. With that view I proceeded to experiment on kelp lyes; I soon found, however, that easy as it was, comparatively speaking, to obtain iodine from the pure alkaline iodides, yet the complicated nature of lyes made it exceedingly difficult. I had therefore to put the lye through a course of preparation or purification before the precipitant could be brought to bear upon it, which difficulty, after performing numerous experiments, I entirely overcame.

I now proceed to give the process in detail, and doubt not but that it will be appreciated by operative chemists in general as a ready mode of preparing iodine:—

Take from eighteen to twenty ounces (fluid) of strong sulphuric acid, and mix it with an equal quantity of water; stir well, and let it stand till cold; then have ready a sufficiently capacious vessel (a stone ware one is preferable) and pour therein one gallon of iodine lye, gradually adding thereto by little at a time the diluted sulphuric acid. A violent effervescence will ensue, accompanied with the disengagement of carbonic, chloric, sulphurous, hyposulphurous acid, and sulphuretted hydrogen gases. This should be done in the open air so as to avoid inhaling the fumes, and allowed to rest for thirty or forty-eight hours to deposit the sulphate of soda, formed by the decomposition of the chloride of sodium and carbonate of soda by the action of the sulphuric acid—the chloride and sulphate of potassa having been for the most part extracted by the previous concentration and crystallisation of the liquor. A large quantity of free sulphur will also be deposited. The contents may be poured out on a fine hair sieve, along with the salts, and well drained, and washed with more water until no trace of iodine is observed on applying the test to the passing liquid; or it can be strained through a stout cloth—after which the filtered liquor should be placed in a stone ware vessel or evaporating dish, and heat applied for some time so as to cause a further deposition of free sulphur. When one third has evaporated away, the liquor should be carefully neutralised with a sufficiency of common carbonate of soda (the necessary quantity being previously ascertained by a trial experiment with a solution of soda in four parts of boiling water); the effect of the addition of the soda will be, besides neutralising any free acid—to throw down the silica which exists in considerable quantity in the liquor, possibly as iodide of silicium and sodium. The heat must now be continued till the liquor has evaporated to one gallon, the original quantity, and if during the evaporation it should by oxidation of the sulphur have acquired any acidity, that must be neutralised with a little caustic potash or soda, when it is fit for the precipitation of the iodine. It is better perhaps

to evaporate to somewhat less than a gallon, allow it to cool, and then make up to the gallon with more water. This will get rid of a portion of the saline matter which crystallises, as it cools.

Having stated the method by which the iodine is precipitated, before proceeding on the larger scale, it is necessary to institute two or three preliminary experiments in order to ascertain the exact amount of iodine contained in a given quantity of the lye, and to adjust the proportions of the precipitant.

To make the test experiments on a larger quantity than a few ounces of the lye would, besides being less manageable, be perfectly unnecessary as well as expensive. We therefore take two or four ounces of the prepared lye, and add thereto by small quantities at a time a sufficient quantity of the precipitant until it ceases to throw down more iodine, occasionally giving the mixture a brisk agitation with a glass rod.

This operation is best performed in a conical glass vessel, and afterwards set aside for about an hour, so that the precipitated iodine may be collected at the bottom.

In operating with kelp lyes, I have found that it requires more of the precipitant than when the pure iodides or iodates are used, every grain of iodine precipitated requiring two equivalents of the chromic salt, and six or eight of sulphuric or hydrochloric acid.

The supernatant liquor after some time becomes changed to a dark green, owing to the sesquioxide of chromium which is formed and retained in solution by the sulphuric and hyposulphuric acids—this should be gently decanted and preserved for future precipitation with an alkali. Strong spirit of wine should now be poured on the residuum so as to dissolve out the iodine; two or three washings will extract all the iodine from the adhering sulphate of potash.

In the mean time a solution of nitrate of silver in distilled water, should be made and carefully mixed with the alcoholic solutions of iodine until all color and smell are destroyed, when a pale yellow precipitate of iodide of silver will be obtained; or the iodine may be precipitated with the chloride of palladium, when a black iodide will be formed, which is to be projected on a filter, and after being well washed, dried in an oven or water bath, it can then be weighed and estimated for its contained iodine.

Every $9\frac{1}{2}$ grains iodide of silver being equal to 5 grains iodine.

„ 10 „ iodide of palladium „ 6 „

The hydrated sesquioxide of chromium obtained from the supernatant liquor is useful for coloring glass and porcelain, forming, when fluxed with borax, a beautiful deep green color.

[The object of the author in thus laying this paper before the Association was that by its publication any unjust monopoly may be prevented, circumstances which it is unnecessary to enter into having deprived him of the benefit of his invention. Cases of this kind show the necessity and value of the Patent Negotiating Association, which, by making proper arrangements between inventors and manufacturers, does better for each than he can for himself, and secures for

inventors, who are commonly not gifted with that "business" knowledge to which they not unfrequently find themselves made victims, a legitimate remuneration for their ingenuity, and gives to manufacturers a guarantee against the designs of that unworthy class of inventors who have brought genius into disrepute.]

On the ELECTRO-CHEMICAL DEPOSITION of METALS.

By ALEXANDER WATT.

(Continued from page 9.)

ELECTRO-DEPOSITION OF GOLD (*continued*).

THE gold solution being raised to the temperature of about 130° F., the operator now proceeds to arrange the battery. The wire which issues from the copper of the battery is to be attached to a piece of fine gold either by soldering or by cutting a strip nearly off the gold plate, which may be fastened to the copper wire, by twisting it tightly round the same. The article to be gilt is to be suspended to the wire proceeding from the zinc of the battery.

Preparation of articles to be gilt.—Silver goods, such as cream ewers, sugar bowls, mugs, &c., should be well cleaned with hot soap and water, to which a little caustic soda or potassa has been added, they are then to be rinsed in hot water; they may then be well scratch-brushed, and lastly plunged into boiling water. The insides, only, of these vessels are generally required to be gilt, in which case the outsides may be wiped dry and the negative wire (zinc) be attached to the handle of the vessel. The plate of gold is now to be carefully suspended in the centre of the vessel, taking care that it does not touch it, and the gold solution is to be poured in until it reaches the upper edge of the vessel. If it is desirable to gild the extreme edge, the solution may be guided over it by means of a piece of wood or a small glass stirrer. In about five or six minutes the vessel will be well-gilt, when the anode may be removed, the negative wire detached and the solution poured into another vessel. The article is now to be rinsed and scratch-brushed, and may be burnished in the ordinary way. When cream ewers, &c., are so constructed that the solution will not reach the lip, &c., without overflowing, it is advisable to slightly tilt the vessel a little so as to cover as much of it as possible, and when it is gilt, the lip may be dipped into a little gold solution until covered, in which case the outsides of the lip will also receive a deposit. This may be prevented by previously coating that surface with the composition described in a former paper.

Silver, brooches, pins, rings, thimbles, egg, salt, mustard spoons, &c., merely require to be scratch-brushed before being immersed in the solution. After they have received the required deposit, the articles may be well scratch-brushed, and if the color be a little too pale or too red, they may be dipped into the solution again *for an instant* and quickly plunged into boiling water, when they will assume a beautiful fine gold color. The articles may now be placed into box sawdust,

which may sometimes be kept hot in order to dry them as speedily as possible, but care must be taken that the dust be not allowed to char or burn, otherwise it will tarnish or stain the articles.

Goods which are made of copper or brass entirely may be dipped into nitrous acid ("fuming nitric acid" or "dipping acid") and instantly plunged into clean cold water; after which operation they may be again rinsed and placed in the gilding bath. Or the articles may be merely scratched, rinsed, and placed in the solution.

If when first placed in the bath, copper or brass articles receive the deposit too quickly, the anode should be raised a little out of the solution, and the articles may be moved about a little, by which uniformity of deposit will be secured. In fact it is advisable always to give the articles a little gentle motion when first placed in the bath, until they have received the first coating, when they may be allowed to remain steady until finished: but if it is requisite to deposit a very stout coating, it will be advantageous to move them occasionally, to prevent the deposit taking place unevenly.

When the articles are made of either copper or brass with mountings of another metal, or if they have been previously plated or gilt, greater care must be observed, otherwise some parts will receive the deposit favorably while others will scarcely be coated at all. This applies more particularly to articles which have mountings pewter-soldered upon them. In this case all surfaces will become coated readily but the solder, which, being a much worse conductor and more electro-negative than the other metal will receive the deposit but tardily, if at all. I have frequently found that the smallest speck of pewter solder being present on an article which I had to gild, has caused me to deposit at least three times the amount of gold required upon the article, before I could get the speck of solder covered, and in many instances, not even then would the deposit take place. Having tried to amalgamate the solder with the gilt surface, by means of the nitrate of mercury, nitrate of silver, and both combined and alternately applied, and having scratched the offending spot until I was heartily sick of pewter solder and everything that it contaminated, I at last hit upon a plan by means of which I have ever since been enabled to gild pewter solder with ease and certainty. I placed a single drop of an acid solution of sulphate of copper upon the solder and then touched it with a piece of steel: in an instant the solder and surrounding surface received a bright deposit of copper (which could be strengthened by repeating the operation several times). The moment the article was placed in the gilding solution the spot became covered, in fact, copper being easier to gild than gold, this spot received the deposit in preference, so that my difficulty was speedily and satisfactorily overcome. Many electro-gilders will, I have no doubt, find the above plan relieve them of a considerable amount of annoyance. When, however, the operator finds a difficulty in gilding pewter solder, it is generally owing to the solution requiring cyanide, or the exposure of a large surface of anode: or perhaps the battery may work tardily. Any of these circumstances will mar the success of the operation.

Instead of the above plan for the coating of pewter solder, the manipulator may put a drop of concentrated silver solution upon the solder, as before, and, by touching the part with a piece of zinc wire, the solder will immediately become covered with silver; I prefer the former, however, owing to the facility with which copper receives the deposit in comparison with gold or silver.

In gilding cheap jewellery, French and Birmingham fancy goods and articles which are not required to have any more than a *colored surface* given to them, I have found that the most economical plan is to gild them with a copper anode, that is to say, to work from the solution instead of working from the anode. By this arrangement, the operator is sure not to deposit more gold upon his work than is consistent with the scale of remuneration for doing the same. Generally speaking, it is only necessary to scratch-brush the above class of goods, then, having rinsed them in hot water, to dip them in the solution bath for an instant in connection with negative wire, and in all probability from half a minute to a minute and a half will be long enough to accomplish the desired object.

Silver filagree brooches, &c., must be well scratch-brushed, dipped for a little while in the gilding bath, scratched again, and then allowed to remain in the bath until they are sufficiently coated, when they may be again scratched, and, if they require it, dipped into the solution again for an instant, to give them the required color. Sometimes, when the battery power is weak, or when the solution requires cyanide, the solder of the filagree work, does not receive the deposit as favorably as the other surfaces, in which case it is advisable either to increase the action of the battery or to employ another cell, or to add a little fresh cyanide to the gilding bath. It is as well, also, to gently move the article about in the solution, by which means the various parts will become equally coated. The solution for gilding filagree work should contain rather more gold than that used for ordinary purposes. It is likewise necessary to expose a larger surface of anode, otherwise the deposit takes place too slowly.

Metal brooches, pins, rings, &c., should be either dipped in nitrous acid and rinsed or be well scratched. This class of goods may be done on the large scale, in a vessel like a cullender, suspended in the solution, the articles being touched by the negative wire, with which they are occasionally stirred, so as to expose those surfaces which have been touching each other, to the action of the bath.

Army accoutrement work, sword mountings, &c., should be first prepared by cleaning with silver sand, soap and water, applied with a hard brush. It may then be scratch-brushed and placed in the solution until it has *nearly* acquired a sufficient coating, when it is to be removed and those parts which are to be left *dead* may be brushed over with powdered pumice-stone or Bath brick. The article may now be returned to the solution and allowed to remain there until finished. As soon as the required coating is obtained, the article may be carefully scratched (taking care not to scratch those surfaces which are required to be dead, and then burnished. I have found that by using fourpenny

ale while burnishing, instead of the soap and water generally used by burnishers for this purpose, the articles have looked much better when finished, and the burnishers when questioned on the subject always preferred the ale, as, in case the gilding be what is termed "hard" or "scratchy" it is less likely to resist the action of the steel or blood stone burnisher. Vinegar, I believe, has sometimes been applied to the burnishing of gilt work, but I think that the fourpenny ale will be found more useful for the purpose.

In gilding German silver, the solution may be worked at rather a lower temperature than is required for the other metals referred to, and a less surface of anode may be exposed. German silver has the power of reducing gold from its solution (especially if the latter be strong) without the aid of battery power, as also will brass receive a deposit of silver in the silvering bath without the battery, therefore it is advisable to use a weaker solution, in fact one which would not coat the German silver *per se*, otherwise the deposition would take place too rapidly, and the work would strip or peel off when being burnished or even when scratch-brushed.

When iron or steel articles are to be gilt, they should be first rendered free from grease by being immersed in a solution of caustic soda or potassa, they may then be well scratch-brushed, in fact until they have acquired a slight coating of brass, from the wires of the brush. The articles may then be dipped in the solution for an instant, then scratch-brushed and again gilt. The solution employed for this purpose should be composed of:—

Ordinary solution	.	.	.	.	4 fluid ounces.
Water	.	.	.	.	20 ounces.
Cyanide of potassium	.			(about)	2 drachms.

This solution may be worked rather warm, but not so hot as the ordinary solution. Weak battery power should be employed, and the surface of anode exposed merely sufficient to enable deposition to take place very slowly.

I have sometimes found that by scratch-brushing steel or iron articles with vinegar, or dilute hydrochloric acid, I have been enabled to impart to the article a very good and adhesive coating of copper, which has enhanced the success of my gilding operation considerably.

The best method of preparing articles of steel, or iron to be gilt, is to deposit a coating of copper by the alkaline coppering bath before described, or to electro-brass them by any of the processes to be dwelt upon hereafter. Many articles of steel, which only require a small amount of gold upon them, may be gilt without being previously coated either with copper or brass, steel beads, purse rings, pens &c., may be dipped in the gilding bath for an instant, and, as soon as they are of a good color they may be rinsed and quickly dried, either by exposing them in an oven or by placing them in hot sawdust or hot sand, the latter being in some respects preferable.

Surgical instruments should be gilt with great care; in order that the edges of the instruments might not be rendered blunt by the opera-

tion it is advisable to gild them directly, as coating them with copper or brass and then gold may render the edges too thick for use. A slight deposit is all that is required to protect the steel instrument from rust or corrosion.

Steel or iron keys should be well scratch-brushed, dipped into the solution for a moment, scratched again, and then replaced in the solution, until finished, when they may either be burnished or polished. When the coating is not very adhesive, through any fault of the manipulation, the article may strip when the burnisher is applied to it; in which case it had better be polished, or stripped, and properly re-gilt.

London, October 15, 1855.

(To be continued.)

A NEW METHOD of DETECTING ADULTERATIONS or MIXTURES of COFFEE and CHICORY.*

By Mr. JOHN HORSLEY, of Cheltenham.

IN consequence of some excise prosecutions which have recently taken place in this neighborhood for the adulterations of coffee with chicory, my attention was necessarily directed to the subject, with a view, if possible, to arrive at a more satisfactory method of detecting fraud, as well as discriminating between these substances in their pure and *mixed* states.

Hitherto chemistry has not been of much avail in this respect, it being considered a difficult thing at best, in consequence of the *limited* as well as indecisive character of the re-agents used; the principal reliance being placed on the *microscope* in detecting the ligneous or fibrous structure of chicory root, which, after all, is not of a decisive character, since that instrument will show other ligneous matter besides chicory root. Nothing but the peculiar reactions of a good *chemical test* can with absolute certainty be relied upon.

I therefore beg to offer an exceedingly sensitive one in the bichromate of potassa. This salt will be found to produce no discoloration of an infusion or decoction of chicory; on the other hand the *most dilute* solution of coffee gradually becomes changed to a *deep porter brown color*, which is not at all connected with the coloring matter of coffee, but with the gallic acid existing in the berry, as a decoction of the white unroasted berry will produce a similar result, this may be proved by boiling the berries in water, and then throwing in a crystal of the chromic salt, when the liquor soon becomes brown and the berries stained throughout, which is not the case with caffen or tannin. Such is the method I propose for distinguishing these substances in their *pure* states.

It may be urged that if this salt reacts thus with pure coffee, will it not proportionally so on a mixture of that article with chicory?

* Read at the Meeting of the British Association at Glasgow.

This then affords us an excellent means not only of detecting coffee, but estimating its quantity by a kind of approximative test.

If we add to the mixture of chicory and coffee, which has been boiled with the bichromate of potash, a few grains of sulphate of copper, and then boil the liquid, we cause the formation of a flocculent precipitate of a more or less deep sepia brown color—the intensity of which varies with the quantity of coffee contained—from which by a series of experiments with known quantities it is easy to adjust a *graded standard of tints* as follows:—

All. Coffee.	Three-quarters. Coffee.	Half. Coffee.	Quarter. Coffee.	All. Chicory.
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The following will be found to be the best method of procedure.

Take an equal weight of chicory and coffee, and make *separate* infusions or decoctions in a given quantity of water, filter the liquors, put them into vials and label respectively.

Then take a tea-spoonful of the infusion of chicory and dilute with water until the liquid be of a *brown sherry wine color*—boil this in a white ware dish, and add a small fragment of crystallised bichromate of potassa—the liquid will be scarcely altered in color.

Next treat a similarly diluted infusion of coffee, boil, and throw in a fragment of bichromate, the liquid will now assume a deep porter brown color; a reaction which is very decided.

By the addition, as before stated, of a few grains of sulphate of copper and boiling, a precipitate will be obtained from *both* infusions, but that from chicory, if viewed in a glass vessel, is of a *clayish yellow* color, whilst the precipitate from coffee liquor is *sepia brown*. By thus noticing the shades of the precipitates when mixtures of chicory and coffee are the subjects of investigation, we are enabled to judge of the quantity of coffee as well as chicory from the reactions which take place and a reference to the scale of tints.

M. Lassaigne has noticed the reaction which takes place when a persalt of iron is added to an infusion of coffee.

A few drops of tincture of the sesquichloride of iron imparts to it a dirty blue green, but I do not find, as M. Lassaigne states, that a precipitate forms. This reagent does not produce any sensible change with an infusion of chicory.

Again, the diacetate of lead produces with pure chicory a deep *brown* gelatinous precipitate: but with coffee a gelatinous *grey-colored* precipitate. No reagent, however, that I am aware of, is so decided in its character as that which I have proposed.

CHEMICAL TABLES. COMPILED BY THORNTON J. HERAPATH.

No. IV.—Table showing the Behavior of Substances with Reagents, and for Testing by the Blowpipe:—Proximate Organic Analysis.

Distinctive Reactions are printed in *italics*. Precipitants used in quantitative analysis are distinguished by an *.

B'.—INORGANIC SUBSTANCES:—ACIDS.

CLASS III.—NON-METALLIC ACIDS, OR ACIDS WHICH ARE NEITHER PRECIPITATED BY SULPHURETTED HYDROGEN NOR BY HYDROSULPHATE OF AMMONIA.

Sub-Class II.—Acids which are not precipitated from their Neutral Solutions by Nitrate of Baryta.

**** Barytic precipitate soluble in boiling Hydrochloric Acid without effervescence.**

(Continued from p. 13.)

Acids.	Color of the precipitated sulphide.	Action of Special Tests, and Behavior before the Blowpipe.
Perchloric acid		Perchlorates are not decomp. by <i>sulphuric</i> or <i>hydrochloric acid in the cold</i> . <i>Potash</i> ,* <i>white granular crystal ppt.</i> <i>B. B.</i> —Both the chlorates and perchlorates deflagrate with charcoal. Heated on platinum foil, they evolve oxygen, and are converted into <i>chlorides</i> . (<i>Vide hydrochloric acid</i>).
Hyposulphuric acid		Is decomp. by heat into sulphurous and sulphuric acids, but does not give a <i>ppt. of sulphur</i> .

C'.—ORGANIC SUBSTANCES.—ACIDS.

CLASS I.—VOLATILE ACIDS.

Sub-Class I.—Volatile Oily acids.

* *Acids, the Barytic Salts of which are but sparingly sol. in cold water.*

Names of Acid, and Composition.	Atomic Weight.	Action of Special Tests, &c.
Capric acid, C ²⁰ , H ⁴⁰ , O ³ , in combination.	163	<i>Possesses a rank goat-like odor. Barytic salt is almost insol. even in boiling water, and cryst. in small acicular and dendritic cryst.</i>
Caprylic acid, C ¹⁸ , H ³⁶ , O ³ , in combin.	135	The barytic salt is consid. more sol. than the preceding, and cryst. in nacreous scales, or small granules. <i>The acid itself possesses a somewhat agreeable odor.</i>

Name of Acid, and Composition.	Atomic Weight.	Action of Special Tests, &c.
** Barytic Salts soluble in cold water.		
Valeric, or Val- erianic acid, C ¹⁰ , H ²⁰ , O ³ , in combin.	93	<i>Odor, intense, and similar to that of oil of valerian.</i> Barytic salt cryst. in small prisms. <i>Magnesia salt possesses a remarkably sweet taste.</i>
Capronic acid, C ¹² , H ²⁴ , O ³ , in combin.	107	Odor resembles that of sweat. The barytic salt is more sol. in water than that of the preceding, and cryst. in aciculae.
Butyric acid, C ⁸ , H ¹⁶ , O ³ , in combination.	79	Odor resembles that of a mixture of acetic acid and rancid butter. Barytic salt cryst. in granules and lamellae; <i>is more sol. than the capronate.</i> Lime-salt less sol. in hot than in cold water.
Sub-Class II.—Acids, volatile, but not Oily.		
Benzoic acid, C ¹⁴ , H ⁸ , O ³ , in combin.	118	<i>Cryst. in colorless prisms, or soft satiny plates. Usually possesses a peculiarly grateful odor.</i> Almost insol. in water. <i>Salts of perox. of iron, fawn-colored ppt. insol. even in boiling water.</i> Nitrate of silver, white and curdy. Does not reduce salts of silver and platinum.
Succinic acid, C ⁸ , H ⁸ , O ⁴ , in combination.	50	<i>Cryst. in small prisms, or rhombic or hexagonal tables.</i> Very similar in character to preceding; <i>but differs from it in being almost insol. in oil of turpentine.</i>
Formic acid, C ² , H ² , O ³ , in combination.	37	Acid, liquid. <i>Reduces salts of silver,* gold,* platinum,* &c., when heated, to the metal. state, evolving carb. acid; and converts chloride mercury* into white insol. calomel.</i>
Acetic acid, C ⁴ , H ⁴ , O ⁴ , in combination.	51	Acid, liquid. Does not reduce or ppt. metallic salts, except salts of silver, which, in concn. sol. <i>yield long white brilliant needle-formed crys.</i> On adding perchloride of iron to an alkal. acetate, a deep red-colored liq. is produced, <i>which on boiling yields a brick-dust ppt.</i> When an acetate is heated with alcohol and sulphuric acid, <i>acetic ether is developed, which may be recognised by its odor.</i>
CLASS II.—NON-VOLATILE ACIDS.		
Sub-Class I.—Fatty Acids.		
* Acids Liquid at Ordinary Temperatures.		
Oleic acid, C ¹⁸ , H ³⁶ , O ⁴ , in combination.	335	<i>Odor, slight.</i> Oleate of lead is soluble in ether. Binoleate of potassa, when dissolved in 20 to 24 pts. of alcohol, does not separate on cooling.
Phocenic acid, C ¹⁶ , H ³² , O ⁴ , in combin.	91	Is somewhat volatile. <i>Odor, rank and acetic.</i> It exists in spermaceti, porpoise-oil, cod-liver oil, and the berries of <i>Viburnum</i> . It is very similar to the preceding.

Name of Acid, and Composition.	Atomic Weight.	Action of Special Tests, &c.
** Acids Solid at Ordinary Temperatures.		
Stearic acid. C ¹⁸ , H ³⁶ , O ⁴ , in combin.	514	Bibasic. Lead-salt insol. in ether. Bistearate of potassa, when dissolved in 20 to 24 pts. of alcohol, entirely separates on cooling.
Margaric acid, C ¹⁸ , H ³⁶ , O ⁴ , in combin.	522	Bibasic. Very similar in character to the preceding, but is more fus. <i>Vide</i> Table II. Lead-salt is insol. in ether. Potash-salt is sol. in 20 to 24 pts. of alcohol, but is less sol. than the oleate.
Sub-Class II.—Acids, not Fatty.		
* Acids which produce a bluish-black coloration with per-salts of iron.		
Tannic acid, (Tannic), C ¹² , H ⁸ , O ⁶ , in combination.	185	<i>Acid, tribasic?</i> Chloride barium, white, sol. in excess of acid. Nitrate of silver and acetate of lead, ditto. <i>Solu. of gelatine (glue)*, yellowish flocks.</i>
Gallic acid, C ⁷ , H, O ³ , in com- bination.	67	<i>Cryst. in long silky prisms. Does not ppt. gelatine, but in other respects is very similar to the preceding. Acid, bibasic.</i>
** Acids which do not produce a dark coloration with per-salts of iron; but give a granular cryst. ppt. with Acetate of Potash.		
Uric acid, C ¹⁰ , H ² , O ⁴ , N ⁴ , in combination.	150	Bibasic. <i>The acid is almost tasteless, and very sp. sol. in water; cryst. in short prisms or rhomboids. When acted upon by boiling nitric acid, and the solution is evap. to dryness and treated with an excess of ammonia, it yields a beautiful purple solution.</i>
Tartaric acid, C ⁸ , H ⁴ , O ¹⁰ , in combination.	132	Tartaric acid and the tartrates, when heated, evolve a peculiar odor, and become blackened when heated with sulphuric acid. <i>The lime-salt is sol. in an excess of tartaric acid, and also in dil. hydrochloric acid. A solution of sulphate of lime yields a ppt. only after some time. Acid, bibasic.</i>
Racemic acid, C ⁸ , H ² , O ⁸ , in combination.	66	Very similar in character to the preceding. <i>Solution of sulphate of lime gives an immediate ppt., which is not sol. in an excess of acid. Acid, monobasic.</i>
*** Acids which neither strike a black color with salts of iron, nor give a precipitate with salts of potash.		
Oxalic acid, C ² , O ² , in combi- nation.	36	<i>Vide</i> page 10 of the present volume of THE CHEMIST.
Citric acid, C ¹² , H ⁸ , O ¹¹ , in combination.	165	Acid, tribasic. Cryst. readily in long prisms. <i>Nitrate of lime, white almost insol. in a solution of muriate of ammonia, but readily sol. in citrate of ammonia. Lime-water, in excess, none when cold, but solu. becomes opaque on boiling.</i>
Malic acid, C ⁶ , H ⁴ , O ⁸ , in combination.	116	Acid, bibasic. <i>Almost uncrystal. Nitrate of lime, white, sol. in hot water and salts of ammonia. Lead-salt, white, very sol. in boiling water.</i>

NOTES ON ANALYSIS *by* MEASURE.

By R. WEST PEARSON, Manchester.

ESTIMATION OF LEAD.

THE mode I have to propose for estimating lead by measure, can be executed in the presence of the oxides of mercury, copper, cadmium, bismuth, and silver; which, including lead, constitute the fifth group in the course of analysis. Lead may also be estimated in solutions of the metals generally; neutral chromate of potash decomposes most soluble salts of metallic oxides by double affinity; the precipitated chromates are difficultly soluble,—some are perfectly insoluble. Bichromate of potash, on the contrary, forms bichromate compounds, without exception soluble in water. Bichromate of potash, however, yields, on addition to salts of lead, the simple chromate of lead, PbO, CrO_3 . This simple combination of bichromate of potash with a soluble metallic oxide, producing an insoluble compound, takes place with lead only. I have tried the greater number of metals with which chromate of potash combines. On this department I have based a method for the determination of lead in its solution:—75·6 grs. bichromate of potash contain 52 grs. of chromic acid, 1 equiv. of chromic acid and 52· combines with 1 equiv. of lead 104· to produce chromate of lead. If, therefore, the amount of bichromate of potash required to remove lead from its solution be known, we also know the amount of lead present in such solution.

If, therefore, we dissolve 15·12 grs. of dry and pure crystallised bichromate of potash in 15·12 grs. of distilled water, we obtain a solution 75·6 grs. of which contain bichromate of potash equivalent to 1 gr. of lead. I propose to apply it in precisely the same manner as given in my method for estimating the amount of baryta in presence of the alkaline earths, invariably using standard solutions of pure bichromate of potash. The solution containing lead to be estimated should be acidified with acetic acid. An excess of nitric or hydrochloric acid is to be guarded against. If free nitric or hydrochloric acid is present in quantity, it is to be replaced by acetic acid, by means of acetate of soda. The lead, as precipitated in a warm solution, is rapidly deposited. On adding an excess of bichromate of potash, a yellow tinge is imparted to the liquor, which may be seen on adding 5000th of a grain in excess. This color is so delicate an indicator as to dispense with the use of tincture of litmus mentioned in the process for estimating baryta. By the use of bichromate of potash, lead may be separated from other metals with far less manipulation, and consequent accuracy, than by any method hitherto proposed with which I am acquainted. Chromates of potash might be applied to separate and distinguish a great number of substances from each other.

The following experiments will serve as a critical illustration of this method for the estimation of lead:—

- a. Ten grs. of pure lead and 20 grs. of pure nitric acid were put into a flask, dissolved and evaporated to a pasty mixture, then

diluted with distilled water until the volume of the liquid was 10,000 grs., consequently 1,000 grs. contained 1 gr. of lead in solution; 1,000 grs. was found to contain:—

When tested by the above method	1.17 grs. of lead.
Actual amount present	1.00 „

Difference	0.17 „
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- b.* In a similar manner I prepared a pure solution of lead, containing in 1,000 grs. 2 grs. of solution of pure lead.

Found by the above method	2.08 grs. of lead.
Found by weighing as chromate of lead	1.96 „

Difference	0.12 „
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- c.* Determined the amount of lead present in a solution of acetate of lead of unknown strength. The means of several experiments gave as present in 1,000 grs.—

According to the above method	5.43 grs. of lead.
Obtained by weighing as chromate of lead	5.34 „

Difference	0.09 „
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- d.* Determined the amount of lead present in a solution of unknown strength containing lead, mercury, silver, and tin in solution. The mean of three experiments gave as present in 1000 grs.—

Estimation by measure as above	6.78 grs. of lead.
Obtained by weighing	6.67 „

Difference	0.11 „
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From these experimental results it would seem that the results obtained by determining lead by measure are rather above than below.

It is best to operate upon solutions not too concentrated; by using solutions of a moderate strength we can obtain very fair results. Determining the chromate of lead by weight gives results a little too low, but much more accurately than by the use of sulphuric acid. It has occurred to me that a very useful addition might be made in the mode of analysis by measure; viz., after obtaining the yellow color that indicates an excess of chromic acid, add from a dilute solution of known strength of acetate of lead until the color disappears. The mean of these two experiments would probably be as near accurate as possible.

One feature in this communication is to recommend the invariable use of bichromate of potash in the separation and estimation of lead; instead of neutral chromate of potash at present recommended in analytical hand-books. Chromate of potash, except in absolutely pure solutions, fails to precipitate the lead as chromate, free from other metallic chromates, whereas I have fully shown, bichromate of potash invariably yields with lead in solution, the pure bichromate thus separating it.

By referring to the preceding number of *THE CHEMIST*, the method I propose for estimating lead will be apparent, and thus needless repetition will be avoided.

TRANSLATIONS AND ABSTRACTS.

CHEMICAL PHILOSOPHY.

CONTRIBUTIONS *to the* HISTORY of SALINE DOUBLE DECOMPOSITION.
ACTION of GLUCOSE on the SALTS of COPPER in presence of the
ACETATES. By M. ALVARO REYNOSO.

THE phenomena which occur when we mix two soluble salts which are not capable of giving rise, by double decomposition, to an insoluble product, constitute one of the most obscure points of the history of salts. As mostly we do not remark any sensible reactions, it is very difficult to decide the true state of the compounds existing in the liquor. According to some chemists, when two soluble salts are mixed, four salts exist in the medium in which the reaction takes place, which salts remain mixed, their separation not being capable of being effected, because they are all soluble. According to other chemists, the two salts are merely mixed, and no chemical phenomenon follows. Finally, others accept only a complete double decomposition, which is not always effected. We think that the formation of four salts occurs only in as much as the production of new salts changing the conditions of the reaction, prevents the latter from continuing; but if the formation of these new compounds introduced no change into the condition of the reactions, and if they remain the same from the commencement until the end, then we see no reason why it should not continue and take place completely, thus giving rise to two new salts.

In this study, certain conditions which may introduce unforeseen perturbations into the result which we desire to obtain are often neglected. Unequally saturated solutions have been operated on, and the relative degree of solubility of the salts mixed has not been well determined previously. When, indeed, the solubility of each of the salts separately has been known, this knowledge has not been sufficient for us to foresee the result of the reaction, for this solubility may change at the moment of mixing the salts. Thus, for example, it is known that a saturated solution of a salt may dissolve a new proportion of it, when a foreign salt is added. The action of the latter may almost always be explained, as M. Margueritte has shown, by a double decomposition giving rise to a more soluble salt; but it remains to be known whether this new salt might not sometimes modify molecularly the salt dissolved, and hence augment its solubility. Moreover, might it not happen that two salts, even of different acids, being dissolved in water, should combine and produce a more soluble double salt?

In the study of these phenomena, frequently no account has been taken either of the relative proportion of the salts mixed or of the temperature at which the mixture is effected. Finally, "the phenomena with which we are occupied," says M. Dumas, "are complicated to such an extent that we cannot hope to discover their laws without having recourse to direct experiments."

The reactions which we have obtained enable us to determine the

existence of a new salt in a liquid, according to the very decided chemical properties of this compound, which properties it alone possesses, and which the original salts do not possess. It is true that in many cases this method, especially for the reactions which we are studying, is not free from objections, and that the final result of the reaction might be explained by the body which intervenes, in order to demonstrate, by its chemical action, the formation of the compound which it is desired to detect. Indeed, this body eliminates, in decomposing, the salt which has been formed in the reaction, and then we are placed in the same condition as when a salt is separated by virtue of its insolubility.

Sulphate of Copper.—It is known that sulphate of copper boiled with glucose for a very long time finishes by being decomposed, and that metallic copper is precipitated. If we mix sulphate of copper with one of the following acetates—soda, potassa, lime, magnesia, zinc, cobalt, nickel or manganese, and if we boil the mixture with glucose, a reduction is immediately obtained, and protoxide of copper is precipitated. This reaction indicates that the sulphate of copper, in contact with one of the acetates above mentioned, is decomposed, and produces acetate of copper, which is reduced by the glucose.

Nitrate of Copper.—This salt being mixed with the acetates of potassa, soda, lime, magnesia, manganese, zinc, cadmium, strontia, nickel, cobalt, lead, and the mixture boiled with glucose, we obtain a precipitate of protoxide of copper. Although this precipitate is also formed in boiling the nitrate of copper alone with the glucose, we cannot hesitate, nevertheless, to admit the formation, by double decomposition, of acetate of copper; for, in this latter case, the reaction took place at the moment of boiling, whilst, when the nitrate of copper occurs alone, the reaction takes place only after very long-continued boiling.

Bichloride of Copper.—When we mix concentrated bichloride of copper with an excess of acetate of soda likewise in very concentrated solution, acetate of copper soon crystallises. At first sight, we therefore thought that, by boiling, the acetate of copper should remain in the mixture. However, experiment shows that, at the boiling temperature, the mixture is composed of bichloride of copper and of acetate of soda, so that heat determines a reaction the inverse of that which takes place at the ordinary temperature. To see this phenomenon well, certain precautions must be employed. When we mix bichloride of copper in excess with acetate of soda, a precipitate is formed, especially by ebullition, which prevents the action of the glucose on the mixture. This same precipitate is formed when we mix with bichloride of copper one of the following acetates—potassa, magnesia, manganese, zinc, cadmium, strontia, cobalt and nickel. This precipitate is also formed when acetate of copper is boiled with an excess of bichloride of copper. It is also formed when we mix chloride of sodium with acetate of copper.

If we pour into a concentrated solution of bichloride of copper an excess of a very concentrated solution of acetate of soda, and if glucose

be added to this mixture, on the liquor being boiled, protochloride of copper is formed, and its presence is more or less marked, according to the quantity of acetate. When the latter is not in very great excess, the protochloride is seen to form, and, in precipitating, allows a colorless liquid to rise. When the acetate of soda is in very great excess, then the protochloride of copper is decomposed by this reagent in proportion as it is produced, and protoxide of copper is produced as a last result.

When acetate of copper is boiled with glucose, whatever may be the excess of sugar, and the duration of the time for which the mixture is kept boiling, we never obtain the complete precipitation of all the copper: some always remains in the liquor. To obtain the complete reduction of the acetate of copper, it is sufficient to previously mix with this salt a great excess of acetate of soda or potassa.

This explains why the complete precipitation of the copper is obtained, when we mix with the sulphate or nitrate of copper a great excess of acetate of soda or potassa, and boil the mixture with glucose.

Sulphate and Nitrate of Sesquioxide of Iron.—Acetate of copper mixed with the sulphate and nitrate of sesquioxide of iron loses the property of being reduced by glucose. This character and the special color of acetate of iron, which appears at the moment of mixing, prove that the acetate of copper is decomposed by the salts of iron.

When we mix acetate of soda with sulphate or nitrate of copper, acetate of copper speedily crystallises.

Comptes Rendus.

MINERALOGY.

On the COMPOSITION of TWO MINERAL SUBSTANCES employed as PIGMENTS. By THOMAS H. ROWNEY, Ph.D.

IN the course of an examination of some mineral substances employed as pigments, which I have lately made in the laboratory of Dr. T. Anderson, I have met with two which, in addition to their practical applications, present considerable scientific interest, their constitution entitling them to be classed as distinct and hitherto unknown mineralogical species.

Indian Red.—The substance named Indian red is imported from the Persian Gulf, but the exact locality in which it is found is unknown, at least I have been unable to obtain any information from the importers. It comes to this country partly in small lumps, and partly as a coarse, hard, and gritty powder. Its color is deep red, with a shade of purple. Its specific gravity is 3.843.

Before the blowpipe, on platinum wire with borax and with microcosmic salt, it gives a transparent bead, with the usual reaction for iron; when heated by itself on charcoal it is infusible, and after cooling it is attracted by the magnet; mixed with carbonate of soda on charcoal it fuses into a bead, the iron at the same time being reduced, and also attracted by the magnet. By digestion with concentrated hy-

drochloric acid a small portion is dissolved, and the remainder retains its red color, and is not further altered by continued application of heat. The portion dissolved consisted of peroxide of iron and alumina, with small quantities of lime, magnesia, sulphuric and carbonic acids. The insoluble portion contained silicic acid, peroxide of iron, and a little alumina and water. The analysis was made by fusing the substance dried at 212° F. with carbonates of potash and soda, and conducting the separation in the usual manner. The results were:—

Silicic acid,	.	.	.	.	.	.	30.17
Peroxide of iron,	.	.	.	.	.	.	56.59
Alumina,	.	.	.	.	.	.	3.79
Lime,	.	.	.	.	.	.	2.65
Magnesia,	.	.	.	.	.	.	1.43
Sulphuric acid,	.	.	.	.	.	.	2.28
Carbonic acid,	.	.	.	.	.	.	1.73
Water,	.	.	.	.	.	.	1.62
							100.26

Another portion was digested with hydrochloric acid, which dissolved 13.66 per cent. of the mineral. The portion dissolved consisted of:—

Peroxide of iron,	.	.	.	.	.	3.91
Alumina,	.	.	.	.	.	2.22
Lime,	.	.	.	.	.	2.65
Magnesia,	.	.	.	.	.	.87
Sulphuric acid,	.	.	.	.	.	2.28
Carbonic acid,	.	.	.	.	.	1.73
						13.66

If, now, we deduct these constituents from the results of the total analysis along with the water, and the slight difference in the magnesia, the insoluble portion consists of:—

Silicic acid,	.	.	.	.	30.17	Oxygen.
Peroxide of iron,	.	.	.	.	52.68	15.96
Alumina,	.	.	.	.	1.57	16.53
					}	

The oxygen in the acid and bases is here almost exactly in the ratio of 1 : 1, and the insoluble portion is therefore a silicate of the peroxide of iron, represented by the formula $\text{Fe}^2 \text{O}^3, \text{Si O}^3$, and corresponding in constitution to the silicate of alumina called xenolite, $\text{Al}^3 \text{O}^3, \text{Si O}^3$. Although the silicate of iron of the constitution $\text{Fe}^2 \text{O}^3 \text{Si O}^3$ has not hitherto been found in the free state, it is known in combination in Wehrlite $(\text{Fe O Ca O})^3 \text{Si O}^3 + 3 (\text{Fe}^2 \text{O}^3 \text{Si O}^3)$, a mineral analogous in constitution to Wernerite and anorthite, which are aluminous minerals both represented by the formula $(\text{Ca O})^3 \text{Si O}^3 + 3 (\text{Al}^3 \text{O}^3, \text{Si O}^3)$.

Terra de Sienna is said to be obtained in the neighborhood of Sienna.

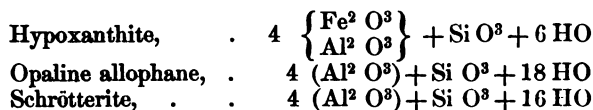
It is a brownish-yellow substance, which acquires a fine and rich chestnut color by ignition, in which state it is used as a paint under the name of burnt sienna. Its fracture is earthy and conchoidal, and it is easily scratched by the nail. Its specific gravity is 3·46. It adheres strongly to the tongue, and absorbs a considerable quantity of water without appearing moist. It gives a transparent bead both with borax and with microcosmic salt with the reaction for iron; with carbonate of soda on charcoal it is reduced and attracted by the magnet, held between platinum forceps and exposed to the reducing flame it is infusible, but is afterwards attracted by the magnet. It is not in the least degree attacked by concentrated hydrochloric acid. It was fused with carbonates of potash and soda, and the various steps of the analysis conducted in the usual way, the iron being determined by means of a standard solution of bichromate of potash.

			Oxygen	
Silicic acid,	. . .	11·14	5·80	1
Alumina,	. . .	9·47	4·41	4
Peroxide of iron,	. . .	65·35	19·60	
Lime,	. . .	·53		
Magnesia,	. . .	·03		
Water,	. . .	13·00	11·33	2
		99·52		

In this case the oxygen of the silicic acid, the sesquiatomic bases, and the water are in the ratio of $1 \div 4 \div 2$, from which we deduce the formula $4 (\text{R}^2 \text{O}^3) \text{Si O}^3 + 6 \text{HO}$, the calculated numbers for which are:—

Silicic acid,		11·04
Alumina and peroxide of iron,		76·09
Water,		12·87
		100·00

The characters and composition of this substance are so distinct from that of all other minerals, that I propose to apply to it the name of hypoxanthite. Although it stands alone among the iron compounds, it may be compared with opaline, allophane, and schrötterite, both of which are hydrated silicates of alumina corresponding in composition with that existing in hypoxanthite, as is seen from the subjoined formulæ:—



Edinburgh New Philosophical Journal, October, 1855.

ANALYSIS of PHOSPHORITE from the SIEBENGEBIRGE.

By R. BLUHME.

Lime,	47.50
Phosphoric acid,	37.33
Alumina,	3.28
Magnesia,	2.70
Carbonic acid,	2.20
Silicic acid,	3.50
Water,	1.65
Loss,	1.84
	100.00

It contained no fluorine, and only traces of chlorine. The phosphate of lime contained in it is the tribasic phosphate, $3\text{CaO}, \text{PO}^5$.

Annalen der Chemie und Pharmacie; and *Edinburgh New Philosophical Journal*.

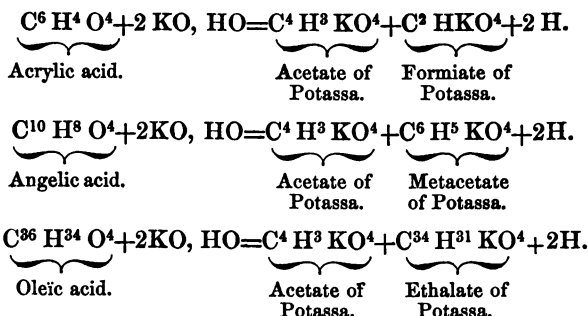
ORGANIC CHEMISTRY.

On the CONSTITUTION of PYROTEREBIC ACID.

By M. JULES CHAUTART, Professor of Physics to the Faculty of Nancy.

THERE exists between angelic acid and several other organic acids relations of composition and properties which admit of our uniting these bodies in a very natural group, the general formula of which is $\text{C}^n \text{H}^n - 2\text{O}^4$. This new series has particularly attracted the attention of chemists by the action which potassa exerts on several of the acids of which it is composed. Under the influence of the alkalis, these acids are decomposed into hydrogen and equal equivalents of acetic acid and of an acid of the series $\text{C}^n \text{H}^n \text{O}^4$.

Thus :—



Other acids, according to their formulæ, are ranged beside the foregoing; it is thus with the damaluric acid of Stadelcr, $\text{C}^{14} \text{H}^{12} \text{O}^4$;

the acid, $C^{26} H^{24} O^4$, found by Heintz in mutton suet; and, finally, the pyroterebic acid of Rabourdin, $C^{12} H^{10} O^4$. By resuming the study of this latter acid, I have ascertained that the action exerted on it by potassa renders it in every respect the homologue of acrylic, angelic, and oleic acids.

It is known that pyroterebic acid is obtained by the action of heat on tererebic acid, discovered by M. Bromeis in the treatment of essence of turpentine with nitric acid. This pyroterebic acid is a colorless oleaginous liquid, heavier than water, boiling at $210^{\circ} C.$ ($410^{\circ} F.$). These last two properties distinguish it from butyric acid, which it resembles in taste and odor.

The analysis of this acid gave me the following numbers:—

0.573 gr. produced	. . .	HO= 0.449 gr.
		CO ² = 1.327 „
Which gives in hundredths	. . .	H= 8.71 „
		C=63.15 „
M. Rabourdin found	. . .	H= 8.78 „
		C=63.04 „

The calcination of the salt of silver enabled me to fix the equivalent of this acid.

0.672 gr. gave as a residue 0.332 of silver, which, in hundredths, amounts to 49.25, instead of 49.54, the theoretical number agreeing with the formula $C^{12} H^9 AgO^4$. The formula of the acid would be $C^{12} H^{10} O^4$, which differs from that of terebic acid $C^{14} H^{10} O^8$, only by two equivalents of carbonic acid, $C^2 O^4$.

When pyroterebic acid is dropped into potassa in fusion, this acid is decomposed, giving rise to an abundant disengagement of hydrogen, and to a mixture of equal equivalents of acetic acid and butyric acid, which remain united with the potassa.

The best means of separating these two acids from each other consists in employing the process indicated by M. Liebig. The salt of potassa is distilled with a slight excess of sulphuric acid, and then half the mixture of the two acids is thus set free saturated with an alkali; the remaining half of the mixture of acids is afterwards added, and the whole is distilled. The butyric acid distils over, and the acetic acid remains combined with the base employed.

Each of these acids was converted into the salt of silver, which was dried and calcined separately.

The first gave 54.81 of silver per cent., instead of 55.33, the theoretical number of the butyrate.

The second gave 63.04, instead of 64.67 of silver, which the acetate should furnish.

Journal de Pharmacie, Sept., 1855.

On several PHENOMENA of OXYGENATION.

By M. F. KUHLMANN.

IN repeating in the laboratory of our illustrious confrère, Liebig, some of the remarkable reactions recently discovered by Schönbein, I have been led to make some new observations which appear to me to merit the attention of the Academy.

New Formation of Sulphuric Acid.—Chemists know that several hydrocarbons are resinified in contact with the air, owing to an absorption of oxygen. Most of the essences are in this position, and the siccative oils undergo analogous modifications by slow acidification; but, it was not suspected that these hydrocarbons, before any profound modification had been effected in their constitution and properties, would make in some sort a provision of oxygen in such conditions, that in contact with bodies which have the property of forming more immediately with oxygen an intimate combination, they yield the oxygen absorbed to the latter, and resume their primitive state, becoming susceptible of again attracting oxygen from the air.

The resinifiable essences constitute in these cases, for the benefit of other bodies, sources of oxygen, and play in some measure the part performed by binoxide of nitrogen in the manufacture of sulphuric acid.

When essence of turpentine has been exposed for some days to contact with the air, and agitated with a solution of sulphurous acid in water, the mixture becomes quickly heated, the temperature rises to 50° C. (132° F.), and even higher, and the sulphurous odor very soon disappears, that of the essence alone remaining. In this reaction, which appears to be facilitated by the solar radiation, there is a formation of sulphuric acid at the expense of the oxygen which the essence had attracted, and which had been removed from it by the sulphurous acid before it had time to digest it in some measure, in order to appropriate it in a stable manner.

When we disengage sulphurous gas into a damp flask containing the vapor of the oxygenised essence, the sulphurous acid gradually disappears; on the other hand, when we allow a mixture of an aqueous solution of sulphurous acid and oxygenised essence to become concentrated in contact with the air, the sulphuric acid which is formed carbonises the essence without its being necessary to raise the temperature of the mixture.

The oxygenising action of the aerated essence is not peculiar to sulphurous acid only; it extends to other acids, such as hyposulphurous acid in the sulphites, arsenious acid, &c.

Peculiar Reactions of the Essences in Painting.—The essences, owing to the nature of their constituent principles, may be considered as possessing naturally, and especially under the influence of heat or the sun, a reducing power which is slowly exerted on ceruse and the colored oxides. Whatever this property may be, the resinifiable essences temporarily possess another of a contrary nature, as I have just shown, and which deserves consideration in the study of the mo-

difications which oil-paintings undergo ; it is that of absorbing oxygen by their sole contact with the air. Whence it results that, at the moment of their employment, the essences may exert an oxidising action tending to destroy vegetable colors and to modify certain mineral colors. The following are some facts in support of the opinion I have just advanced :—

Litharge heated with aerated essence of turpentine gives rise to the formation of puce oxide of lead.

When we agitate, at the ordinary temperature, aerated essence of turpentine with hydrated protoxide of iron, tin, or manganese, these oxides pass to a higher degree of oxidation. With a solution of sulphate of protoxide of iron, basic sulphate of the sesquioxide is produced, and separates from the liquid. The white precipitate which the ferrocyanide of potassium forms with a salt of protoxide of iron, immediately takes, in the same circumstances, the deep color of Prussian blue.

Blue and red flowers decolored by sulphurous acid recover their color by contact with the aerated essence. The newly distilled essence does not present any oxygenising property.

In the association of colors applicable to oil painting, there have, therefore, to be considered not only the modifications which may be produced in certain colors by the various reactions of the coloring matters on each other, but also the oxygenising action of the essence which must be manifested soon after its application in the state of varnish.

General Considerations.—In all the reactions which I have just noticed, the essence of turpentine, and in general the essences capable of absorbing oxygen from the air, act as agents of oxidation whose energy is sufficiently characterised by the great elevation of temperature which is produced by the contact of the aerated essence with a solution of sulphurous acid.

It is important to examine whether this oxygenising property may belong to certain oils, and whether we do not find in establishing this fact, the explanation of the spontaneous combustion of oiled tissues, so frequent in the Adrinople red dye-houses and in the workshops in which woollen stuffs are prepared.

There is also considerable interest in examining the action of the vapor of essence on putrid miasmata, and in ascertaining whether there is not, in these cases, a combustion of the principles diffused in the air.

If oxygen may thus be dissolved, without combining, in certain liquids, we are led to believe, that when it is disengaged, it exerts its action on bodies with which it is in contact, in the state of solution before becoming gaseous. Are not the same circumstances presented in all chemical reactions in which, in our explanations, we make nascent gases intervene ?

Thus, we shall be led to investigate whether other bodies do not partake with certain essences the property of forming a provision of oxygen in order to yield this agent for the benefit of certain reactions.

This study may throw great light on the phenomena of vegetable and animal physiology. The solution of oxygen in the blood by the act of respiration and its subsequent assimilation present a great analogy with the phenomena which I have just described. For the sake of public health, it is desirable to examine what may be the consequences of respiring air charged with essence in newly painted or varnished apartments. On the other hand, we know how ill adapted for proper alimentation is water which is not aerated.

I should fear to venture into the field of hazarded hypotheses by pushing these reflections too far, in the point of view in which I have placed myself. The Academy will comprehend my resolve and my desire to justify, by new facts, opinions which I could now present only under the conjectural form.

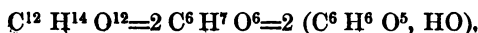
Comptes Rendus, No. 13, Sept. 24, 1855.

On the NEUTRAL COMBINATIONS of SACCHARINE MATTERS with the ACIDS. By M. BERTHELOT.

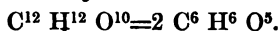
OF the vegetable principles richest in oxygen, a great number form with the acids peculiar combinations. Examples of this kind of compounds are widely diffused in nature (salicine, populine, tannine, &c.); but none have hitherto been prepared by way of synthesis. The object of the present work is the production of combinations of the order of the preceding; it shows that the various saccharine matters contained in vegetables present the greatest analogies with glycerine; the compounds thus formed are neutral, and possess properties and reactions similar to those of the neutral fatty bodies; they are prepared and purified in exactly the same manner.

I will here confine myself to giving the list of the neutral compounds which I have obtained, intending to return to this subject with greater development.

I.—MANNITE.



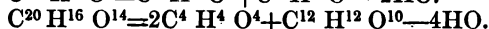
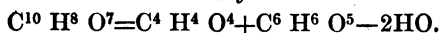
Anhydrous Mannite.



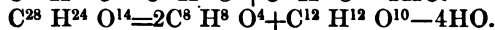
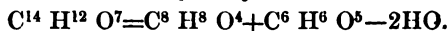
This substance is obtained—1st, by decomposing mannitic combinations by means of acids or alkalis; 2nd, by heating mannite towards 200° C. (392° F.); 3rd, by heating mannite to 100° C. (212° F.) with concentrated hydrochloric acid.

It is a syrupy, saccharine matter, soluble in water and in absolute alcohol; when left for a long time in the air it regenerates mannite.

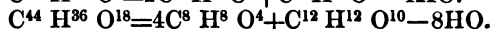
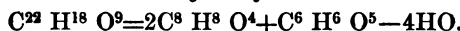
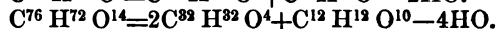
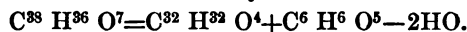
Acetate of Mannite.



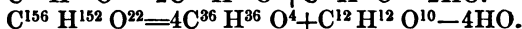
A liquid, bitter matter, obtained, like the following, between 200° and 250° C. (392° and 482° F.)

Butyrate of Mannite.

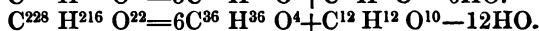
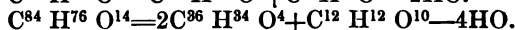
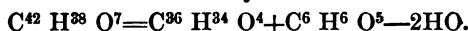
A liquid matter, mixed with crystals similar to oleine, which congeals.

Debutyrate of Mannite.*Palmitate of Mannite.*

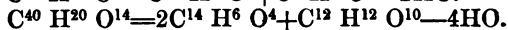
Resembling palmitine.

Distearate of Mannite.

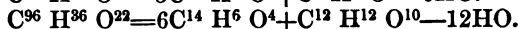
Resembling stearine.

Tristearate of Mannite.*Oleate of Mannite.*

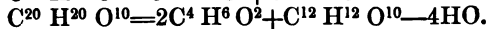
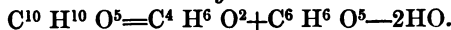
A waxy substance, easily fusible into a viscid liquid.

Benzoate of Mannite.

Resembling benzoicine.

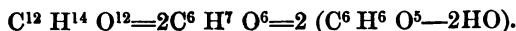
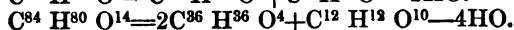
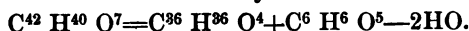
Tribenzoate of Mannite.*Hydrochlorate of Mannite.*

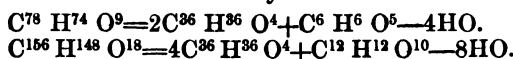
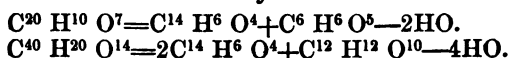
Action of fuming hydrochloric acid at 100° C. (212° F.) on mannite.

Ethylmannite.

Reaction at 100° C. (212° F.) of mannite and potassa on hydrobromic ether.

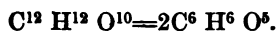
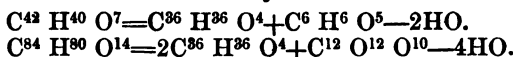
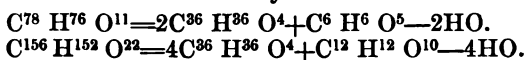
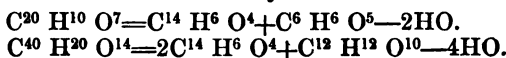
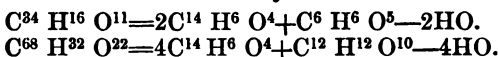
II.—DULCINE.

*Stearate of Dulcine.*

Distearate of Dulcine.*Benzoate of Dulcine.*

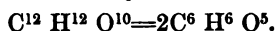
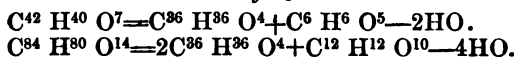
When saponified, they regenerate the original acid and a substance which rapidly changes into dulcine.

III.—PINITE.

*Stearate of Pinite.**Distearate of Pinite.**Benzoate of Pinite.**Dibenzoate of Pinite.*

Saponified, they regenerate the original acid and a substance capable of slowly reproducing pinite.

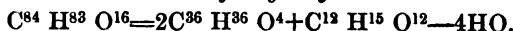
IV.—QUERCITE.

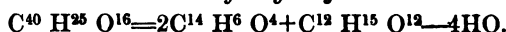
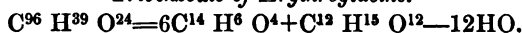
*Stearate of Quercite.**Benzoate of Quercite.*

Saponified, they regenerate the original acid, and, after a long time, quercite.

The foregoing four series are isomeric; they are distinguished by their formation and by their decomposition.

V.—ERYTHROGLUCINE.

*Stearate of Erythroglucine.*

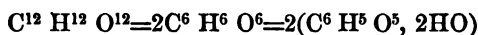
Benzoate of Erythroglucine.*Tribenzoate of Erythroglucine.**Acetate of Erythroglucine.*

When saponified, the original acid and erythroglucine are regenerated.

VI.—ORCINE.

Orcine, heated to 250° C. (482° F.) with stearic acid produces a neutral, solid compound, of a waxy nature. This body is isolated by three successive operations. 1. The excess of orcine is removed by means of water; 2. The excess of stearic acid is removed by means of ether and lime; and 3. It is treated with sulphuret of carbon, which does not dissolve the orcine if any remains. This compound, by saponification, regenerates the stearic acid, and a substance soluble in water and in ether, and colorable by ammoniacal vapors, but which appears to be distinct from orcine.

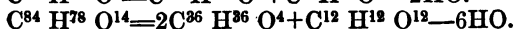
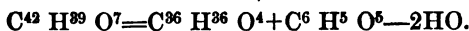
VII.—SUGAR.



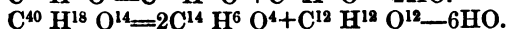
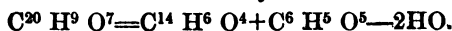
The neutral combinations of sugar with the acids are prepared by heating, between 100° and 120° C. (212° to 248° F.) cane sugar or glucose with the acids. They are extracted, like the artificial fatty bodies, with ether and the alkalis. Their preparation is troublesome, and their purification a delicate operation; moreover, they are obtained only in small quantity. Consequently, I represent them by formulæ only with much reserve.

These compounds resist very energetically the action of the dilute mineral acids, even at 100° C. (212° F.); however, they may be resolved, by dilute sulphuric acid, into acid and fermentable sugar, of which a portion is destroyed during the operation. Hydrochloric acid and alcohol very slowly produce without heat an ether of the acid combined with the sugar, and fermentable sugar.

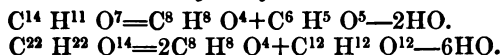
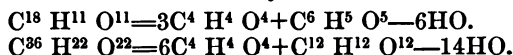
These compounds reduce with heat the tartrate of copper and potassa. This reaction, joined to their mode of formation, leads us to suppose that they contain glucose. Concentrated sulphuric acid blackens them instantly, even without heat. They do not ferment directly.

Stearate of Glucose.

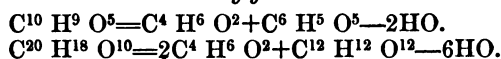
Neutral, resembling stearine.

Benzoate of Glucose.

Neutral, liquid.

Butyrate of Glucose.*Trisacetate of Glucose.*

A neutral, bitter liquid, soluble in water and in ether.

Ethylglucose.

A colored liquid, sparingly soluble in water, obtained like ethylmannite. With dilute sulphuric acid, alcohol and fermentable sugar may be regenerated.

Comptes Rendus, No. 12, Sept. 17, 1855.

On a NEW GLUCOSIDE EXISTING in the PETALS of the WALLFLOWER.

By MR. JOHN GALLETLY, Assistant to Dr. T. Anderson.

A WATERY infusion of the petals of the wallflower has been occasionally employed for the purpose of detecting the presence of free acids or alkalies in solution, giving with the former a fine rose-red, and with the latter a brilliant green. Although it does not appear to exceed in delicacy the substances usually employed for this purpose, I had occasion to make use of it in some experiments, in which it became necessary to ascertain the effect produced by different coloring matters; and in preparing the infusion I detected the substance which forms the subject of the present notice, and for which I propose the name of cheiranthine, derived from that of the genus to which the wallflower belongs.

When the petals, carefully picked from the flowers, are infused for some time in water at a nearly boiling temperature, they lose the dark marks with which they are covered, and acquire a uniform pale yellow color. The infusion has a very pungent smell, due to the presence of a volatile oil containing sulphur, and doubtless identical with that found in other cruciferous plants, and, in addition to the coloring matter and other substances, contains the cheiranthine. The method which I found most advantageous for preparing it consists in covering the petals with boiling water, digesting for some time, filtering the infusion, and adding to it about a fifth of its bulk of alcohol. The fluid is set aside, and in the course of twenty-four hours crystals begin to make their appearance in it, and go on increasing for some days. The whole of the cheiranthine appears to be extracted by the first infusion, or at all events, what remains cannot be obtained, as it appears to become uncrystallisable during the evaporation to which the fluid must be subjected. The crystals are separated from the fluid, and purified by solution in boiling alcohol and digestion with animal charcoal.

Cheiranthine does not crystallise well from its watery solution ; but from alcohol it is obtained in the form of fine tufts of long silky needles of a light-yellow color. It is very sparingly soluble in cold water and alcohol, but dissolves readily in both fluids at the boiling temperature. The hot alcoholic solution becomes nearly solid on cooling. It is very slightly soluble both in cold and boiling ether. It is entirely without action on vegetable colors, and its taste, which is not very marked, is slightly bitter and pungent. It contains only carbon, hydrogen, and oxygen, and its analysis, made on the substance dried at 212°, gave,

I.	{	5.090 grains of substance gave			
		9.750 „ carbonic acid,			
		2.635 „ water.			
II	{	4.865 grains of substance gave			
		9.300 „ carbonic acid,			
		2.410 „ water.			
III.	{	5.330 grains of substance gave			
		10.245 „ carbonic acid,			
		2.820 „ water			
Carbon,	.	.	I.	II.	III.
			52.24	52.13	52.42
Hydrogen,	.	.	5.75	5.50	5.87
Oxygen,	.	.	42.01	42.37	41.71
			100.00	100.00	100.00

These numbers agree with the formula, $C^{40}H^{26}O^{24}$, as is seen by the following comparison of the experimental mean with the calculation :—

	Mean.	Calculation.	
Carbon, . . .	52.26	52.40	C^{40} 240
Hydrogen, . .	5.71	5.67	H^{26} 26
Oxygen, . . .	42.03	41.93	O^{24} 192
			458

Cheiranthine dissolves in alkalis in the cold with a deep orange-yellow color, which disappears on the addition of an acid, and a precipitate slowly forms, which appears to be the unaltered substance. Baryta and lime water, when added to its hot aqueous solution, give a gelatinous orange-colored precipitate, slightly soluble in cold, and rather more so in boiling water; their solutions have a pale-orange color. Perchloride of iron gives a dirty green, almost black color. Subacetate of lead gives an orange precipitate.

The aqueous solution of cheiranthine becomes red when treated with chlorine; bromine gives a light brown precipitate, which dissolves in alcohol, and iodine also appears to exert an influence upon it, the color

of a very dilute tincture of that substance being perceptibly deepened by the addition of cheiranthine. The compounds produced are probably substitution products, but I had not a sufficient quantity of any of them for analysis.

When cheiranthine is boiled with dilute sulphuric acid, a yellow substance precipitates, which is insoluble in water. On removing the acid by means of carbonate of baryta, the fluid is found to have a sweetish taste; and when boiled with sulphate of copper and caustic potash, gave unmistakeable evidence of the presence of sugar. The peculiar odor of saccharine fluids was also distinctly observed during its evaporation. The yellow matter precipitated by sulphuric acid is readily dissolved by a dilute solution of soda.

From these properties, it is obvious that cheiranthine belongs to the group of glucosides, like salicine, phloridzine, &c. To the latter substance it even approximates in constitution, and this similarity extends to the composition of its lead compound. This substance was prepared by adding subacetate of lead to the aqueous solution of cheiranthine, and washing the precipitate, which is orange-yellow, and nearly insoluble in water.

{ 7.73 grains of the lead precipitate gave
4.88 „ oxide of lead.

Experiment.				Calculation.		
Carbon,	.	.	...	22.3	C ⁴⁰	240
Hydrogen,	.	.	...	1.9	H ²⁰	20
Oxygen,	.	.	...	13.4	O ¹⁸	144
Oxide of lead,	.	.	63.1	62.4	6 PbO	669.42
				100.00		1073.42

The formula is therefore C⁴⁰H²⁰O¹⁸, 6PbO. The phloridzate of lead also contains six equivalents of oxide of lead; but there is this difference between it and the cheiranthine compound, that in the latter the oxide of lead replaces an equivalent quantity of water, while in the former that base is directly combined with the unchanged phloridzine. The examination of the lead compounds of the glucosides hitherto investigated is far from complete; but it is to be observed, that the salicine compound is formed by the replacement of four equivalents of water by oxide of lead, and is therefore analogous to the lead salt of cheiranthine.

The foregoing are the results to be drawn from the experiments hitherto made; but as they are founded on a single lead determination, and as several other formulæ might be deduced from the analysis of the cheiranthine itself, they must be considered as in some degree provisional. The season during which wallflowers can be obtained in abundance was nearly over before I commenced this investigation, and the whole of the material I could obtain only sufficed for the observations contained in the preceding pages, which are far from being as

complete as I could have wished. It is my intention, however, to return to the subject next summer, when I shall be able to command a larger quantity of wallflowers. I propose also to extend my inquiry to some other cruciferous plants which may possibly be found to contain it. I may mention, however, that it does not exist in the field mustard, *Sinapis arvensis*, the only other plant I have yet examined.

This investigation was made in the laboratory of Dr. Anderson.—*Edinburgh New Philosophical Journal*, October, 1855.

RESEARCHES ON SOME DERIVATIVES OF NAPHTHALINE.

By M. L. DUSART.

WHEN we make a mixture of two parts of caustic potassa and one of lime, moistened in such a way as to form a thick mass, and project into it gradually one part of protonitrate of naphthaline, the mass immediately takes a reddish-yellow coloration, which is due to the formation of a peculiar acid. It is heated for about six hours, at a temperature not exceeding 100° C. (212° F.), adding from time to time a few drops of water to replace that which has evaporated. After this time, the action is terminated. The mass, washed by decantation until the water is no longer alkaline, is treated with an acid which separates the lime. The product thus obtained contains two matters, one yellow and crystallisable, the other brown and uncrystallisable, which communicates to it its color. It is distilled either by means of steam or with the open fire. This second process is the quickest, but gives a less pure product. In the latter case, we must stop when red vapors begin to appear. The distilled matter crystallises immediately.

The body crystallised in boiling alcohol gives long needles of a straw color, tasteless and of a faint aromatic odor. It melts at 48° C. (118° 4' F.), enters into ebullition at 290° C. (554° F.), and distils in great quantity from 300 to 320° C. (572 to 608° F.), leaving a slight carbonaceous residue. It is very soluble in alcohol, ether, and hydrocarbons. Boiling water dissolves it in small quantity, and allows it to crystallise by cooling. Potassa in very concentrated solution attacks it, giving a yellow acid. Distilled with a mixture of potassa and lime, it gives an odorous yellow oil and long needles, which communicate to sulphuric acid a coloration of a fine violet blue. The oily matter dissolves slightly in water; a few drops of perchloride of iron communicate to the solution an intense blue color, from which are very soon precipitated blue flocks which the alkalis turn red. Sulphuric acid dissolves it with a red color. Sulphuret of ammonium gives a new alkaloid.

Phtalidine: C¹⁶H⁹N.—It is produced by the action of sulphuret of ammonium on nitrate of phtaline. The action is much facilitated by keeping the solution for some hours in a water-bath, at a temperature of about 50° C. (122° F.) After having expelled the alcohol, we

exhaust with dilute hydrochloric acid, and filter after cooling. Potassa causes in it at first a white precipitate which redissolves in the excess of acid with a beautiful blue color: a greater quantity separates the alkaloid under the form of flesh-colored flocks which very soon become red in aggregating. Washed, then crystallised by fusion, it is of the color of realgar: its odor resembles that of naphthalidine. Its taste is pungent and disagreeable.

It fuses at 22°C . (39°F .) At the moment of solidification, the thermometer rose to $34^{\circ}5'\text{C}$. ($94^{\circ}1'\text{F}$.); it begins to boil at 255°C . (491°F .), but the temperature rises rapidly and causes a partial alteration, leaving a carbonaceous residue: it has no action on red-denied litmus, but its vapors immediately restore its blue color. Ether and alcohol dissolve it; cold water dissolves in considerable quantity and deposits it in long needles. Its aqueous solution precipitates the salts of suboxide and protoxide of mercury.

Nitrate of silver is reduced by it. A few drops of perchloride of iron communicate to it a fine blue color. This reaction, which is very delicate, is common to morphia and salicylic acid.

It gives, with all the acids, very well crystallised salts. Bichloride of platinum reduces it when the solution of the hydrochlorate is dilute, giving blue flocks which turn black, on being dried. When the hydrochlorate is in very concentrated solution, this reagent gives beautiful yellow crystals, which are altered by dessication.

I have not, therefore, been able to determine its equivalent by the analyses of the platinum salt.

Nitro-phtalinic Acid: $\text{C}^{22}\text{H}^{14}\text{NO}^{10}$.—It is obtained in the preparation of nitrate of phtaline by a secondary reaction of potassa on this body. It is then impregnated with a foreign matter difficult to eliminate. It is more advantageously prepared by treating pure nitrophtaline with a very concentrated solution of potassa. The formation of this acid is extremely slow.

The salt of potassa obtained is treated with filtered water, and decomposed with hydrochloric acid. It is made to crystallise in a mixture of one part of water and two of alcohol of 36 degrees: it gives by cooling small crystals of a golden yellow, grouped in stars.

It is inodorous, at first having no taste, then becoming pungent: heated in a tube, it fuses, leaving a residue of charcoal.

This salt of potassa is obtained by abandoning the alcoholic solution, which deposits small mamilated reddish yellow crystals. It is very soluble in water, and gives a deep yellow stain.

It gives, with nitrate of silver, a fine red precipitate; with acetate of lead, an orange-colored precipitate; and, with salts of copper, a greenish yellow precipitate.

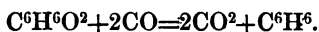
Most of the metallic salts explode with heat.

Comptes Rendus, No. 13, Sept. 24, 1855.

NOTE on a NEW MODE of PRODUCING PROPYLENE.

By M. L. DUSART.

WHEN we distil a mixture of an alkaline acetate and oxalate, so as to put the acetone formed in contact, in the nascent state, with the oxide of carbon produced by the decomposition of the oxalate, there is a deoxidation of the acetone, and formation of carbonate, and there passes over a gas absorbable by bromine, which is no other than propylene. The reaction may be represented by the following equation:—



However, we are far from obtaining the quantity of propylene indicated by theory. The decomposition of the two salts is not simultaneous, and the oily matter which is observed in the preparation of acetone is always produced.

This is the process followed:—We take equivalent quantities of acetate of lime and oxalate of potassa. The oxalate is dissolved in water, and the acetate of lime is added; thus, oxalate of lime and acetate of potassa are produced. The liquid is evaporated, the mass being continually stirred so as to have an intimate mixture. The matter, dried as much as possible, is introduced into a retort, which is heated on a moderate fire. The quantity of propylene appears to increase when we take care to raise the temperature gradually. The gas passes first into a flask filled with carded cotton, then into a flask containing sulphurous acid, which absorbs the oily matter, then it is condensed in bromine after having been washed in water. One kilogramme of acetate of lime gives about 60 grammes of crude propylene.

The liquid obtained is washed with potassa, distilled directly, then agitated again with an alkaline solution which saturates the hydrobromic acid formed during the distillation. It is afterwards dried over chloride of calcium, and distilled with the guidance of the thermometer.

The bromide of propylene forms about two-thirds of the product; it has the odor, and the boiling point 145°C . (293°F .) of the propylene obtained with amylic alcohol.

The compound, $\text{C}^6\text{H}^5\text{Br}$, obtained by the action of potassa-alcohol on the foregoing product, heated in a tube with sulphocyanide of potassium, gave the essence of mustard recently reproduced by M. Berthelot with the ioduretted propylene derived from glycerine. It is thus possible, by a simple deoxidation of acetone, to rise from the acetic series to the propylic series, and to regenerate the alcohol if, instead of collecting the hydrocarbon in bromine, it be absorbed by sulphuric acid and distilled with water, according to the ingenious process of that chemist.

Comptes Rendus.

ANALYTICAL CHEMISTRY.

NEW CHLOROMETRIC PROCESS. By M. NOELLNER.

THIS process is based on the action which chloride of lime exerts on hyposulphite of soda, which has long been known in industry as an antichlore, and on the oxidation of the sulphur of this salt, and its transformation into sulphuric acid in a proportion equivalent to the quantity of chlorine brought into play. The following is the mode of operating :—

We take, for example, 1 gramme of the chloride of lime to be examined, and introduce it into a small flask with 2 grammes of soda, and from 10 to 15 grammes of water ; the flask is closed, and shaken until the hypochlorite is well divided.

The decomposition is effected quickly without heat ; however, it is well to place the flask for some time on a sand-bath ; pure hydrochloric acid is afterwards added in sufficient quantity for destroying the excess of hyposulphite ; this reaction is promptly effected, and gives rise to a deposit of sulphur, and a disengagement of sulphurous acid. It is boiled for a few minutes, to expel the sulphurous acid, the sulphur melts and collects in drops easily separated by filtration. This sulphur is washed in any convenient manner, and the mother-liquors are united with the rest of the liquid, which contains chloride of calcium, arising from the hypochlorite, chloride of sodium, free hydrochloric acid, and a quantity of sulphuric acid corresponding to the chlorine which has produced the oxidation. We have then only to precipitate by means of chloride of barium, and to proceed as for ordinary estimations.

Knowing that two equivalents of chlorine are sufficient for converting hyposulphurous acid into sulphuric acid, the calculation is easily made ; for :—

116·5 parts (1 equiv.) of sulphate of baryta, correspond to 71·5 parts, (2 equiv.) of chlorine.

By this method a good quality of chloride of lime should yield at least half its weight of sulphate of baryta, which corresponds to 30 per cent. of chlorine.

This process is only a complication of that which M. Gelis proposed long ago. That skilful chemist likewise employs hyposulphite of soda, but he uses metrical liquors. His method is, in general, that of Gay-Lussac, with the exception that the reducing agent, arsenious acid, is replaced by hyposulphite of soda.

Journal de Pharmacie, September, 1855.

INORGANIC CHEMISTRY.

ANALYSIS of the WATERS of the BOSPHORUS. By M. F. PISANI.

M. F. PISANI, who performs his chemical studies in the laboratory of M. Pelouze, has addressed to the Academy of Sciences, and to the

Cosmos, an analysis of the water of the Bosphorus, taken at Bujak-Dévé, near the mouth of the Black Sea :—

Water, 1 litre, density 1·01345	
Chloride of sodium	13·8582
Chloride of potassa	0·0298
Chloride of magnesium	1·7940
Sulphate of magnesia	1·2279
Sulphate of lime	0·5169
Carbonate of lime	0·1569

Total saline matters 15·5837

Bromine exists in it in small quantity, but could not be estimated.

The volume of gases contained in a litre of this water, at the temperature of 0° C. (32° F.), and under the pressure of 760^{mm}, was at one time 23·99^{cc}; at another time, 22·27^{cc}; its composition in hundredths was in the first and second case :—

Carbonic acid	33·22	Carbonic acid	27·1
Nitrogen	45·78	Nitrogen	48·7
Oxygen	21·00	Oxygen	24·2
	100·00		100·0

The water of the Bosphorus is not always equally rich in salts; thus, these saline residues, resulting from 100 grammes of water, vary from 1·627 gr. to 1·739 gr. The density itself varies from 1·0121 to 1·0139. The mean density estimated between 22 and 26 centigrade degrees, (71° 6' to 77° 8' F.,) is 1·0134.

The maximum of salt corresponds to the East and North-East winds; the sensible minimum, to the Southerly winds; but the absence of these last winds, for some months, has prevented M. Pisani from proving this last fact more completely.

The quantity of lime increases with the salt, and varies from 0·174 gr. to 0·350 gr. per litre.

The quantity of chlorine varies from 8·853 gr. to 9·623 gr. The other substances undergo only slight variations.

M. Balard, in presenting this interesting analysis to the Academy, remarked, that it appeared from it that, compared with the Mediterranean, the water of the Bosphorus contained much less, indeed less than one-half the amount of salts, and is only a sort of mixture of fresh and salt water.

On CRYSTALLISED HYDRATE of ZINC. By M. BOEDECKER.

In 1848, M. J. Nicklès (see *Journal de Pharmacie* for that year,) made known the chemical composition and the crystalline form of the monohydrate of zinc, which I represented by the formula ZnOHO; it contained 18·27 per cent. of water, and had been obtained by the galvanic way.

M. Boedecker* describes a hydrate which was accidentally deposited in a solution of caustic soda, saturated with oxide of zinc. It was crystallised, and contained 30·70 per cent. of water; consequently it must be represented by the formula ZnOHO . These crystals, whose form has not been determined, appeared to be regular octohedra. They turned white on contact with warm water. The salt which M. Nicklès described turned white only after a long time, and in dry air; and some of it preserved its original lustre. Its crystalline form had, moreover, nothing in common with the regular octohedron; this was that of right rhomboidal prisms of $117^{\circ} 44'$, more or less modified at the summit.

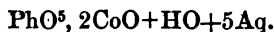
Oxide of zinc may, then, form with water, two definite and crystallised combinations, containing respectively one and two equivalents of water.

CRYSTALLISED PHOSPHATE of PROTOXIDE of COBALT.

By M. BOEDECKER.

By pouring into a solution of protochloride of cobalt a solution of phosphate of soda in slight excess, a flocculent precipitate is obtained, of a lilac color, which is divided into two parts; one is redissolved in hydrochloric acid, avoiding excess; this solution is afterwards added to the other half, and the whole is left to itself. After a sufficient length of time, the flocculent precipitate is transformed into agglomerated crystalline lamellæ, presenting a beautiful violet color.

Dried over sulphuric acid, these crystals produced by calcination 28·75 per cent. of water. They contain 35 per cent. of phosphoric acid, which agrees with the formula



Annalen der Chemie und Pharmacie.

INDUSTRIAL CHEMISTRY.

On a NEW PROCESS of OBTAINING and PURIFYING GLYCERINE. †

By GEO. FERGUSON WILSON, ESQ., F.R.S.

THE paper I was asked to give was one on our new processes of obtaining and of purifying glycerine. I trust, however, you will excuse, as an introduction, a short sketch of the past history of glycerine and its uses, though it will take us over some ground well known to most members present.

Glycerine was discovered in 1789 by Scheele, as a product in the process of lead plaster making, and was called by him the sweet principle

* *Annalen der Chemie und Pharmacie.*

† Part of this paper was read at the Glasgow Meeting of the British Association for the Advancement of Science, Sept. 1855.

of oils. About twenty-five years afterwards it was studied by the father of fatty chemistry, Chevreul, and shown by him to be the base of fats and fat oils. M. Chevreul lately received a specimen of glycerine obtained by our new process, with expressions of extreme pleasure. Nearly half a century has passed since the earliest of those beautiful researches into the constitution of fatty bodies, in the course of which he discovered the function of glycerine, yet our specimen found him still lecturing to his class.

A source of impure glycerine has long existed in the preparation of lead plaster, in which the combination of the litharge with the acids of the olive oil sets the glycerine free; another source is soap-making, the soda or potash setting free the glycerine; and a third source in the stearic candle manufacture, where the lime saponification separates the glycerine. Most of the purifiers of glycerine appear to have preferred this last source.

Notwithstanding the known existence of these great sources of impure glycerine, it was long before glycerine was in any way utilised: hundreds of tons have been and are yearly thrown away.

The first suggestion of a use which we can trace, dates in the beginning of 1844, when Mr. Thomas De la Rue, being engaged on some experiments requiring the use of syrupy substances, procured some glycerine from Mr. Warington, of Apothecaries Hall, some of which he applied to a burn and an irritation of the skin. The experience thus obtained of its properties of soothing and keeping moist, led to its introduction, through Mr. Startin, into the Hospital for Skin Diseases, where it soon came into extensive use.

In 1846 Mr. Warington took out a patent for the use of glycerine as an agent for preserving animal and vegetable substances, and tried many experiments on preserving meat. He informs me that part of a neck of mutton preserved in glycerine for several months, when cooked by Soyer, was partaken of by a gentleman with great satisfaction.

Mr. Warington, I believe, first applied glycerine in mounting objects for the microscope, for which it has proved so successful.

In the *Lancet* of June 1849, Mr. Thomas Wakley published the results of a year's experience in a long and very interesting paper on the Use of Glycerine in Diseases of the Ear, giving a number of cases in which it had proved a cure for deafness. In the Number of the 23rd of the same month his results were confirmed by letters from Mr. Erasmus Wilson and Dr. Gardner, the latter of whom drew attention to the fact that the glycerine should be free not only from any trace of lead, but also as much as possible from water. His theory was, however, better than his practice; for the glycerine he speaks of using, sp. gr. 1.280, being above the density of anhydrous glycerine, must have been impure.

Isolated applications of glycerine had thus been suggested; but M. Cap appears to have been the first to see its extraordinary value in a great variety of medical preparations. His very valuable and interesting papers were published in the *Annales de Pharmacie et de Chimie*, and

translated into *THE CHEMIST*. I shall give two short extracts from them.

M. Cap in his first paper (*Journal de Pharmacie et de Chimie*, February 1854, *CHEMIST*, April 1854) begins by attacking the process of purifying glycerine given in the French chemical books, and shows its defects. He then gives his own process, remarks upon the great value of glycerine in skin diseases, and after suggesting a number of valuable uses, proceeds as follows:—

“Glycerine dissolves the vegetable acids, the deliquescent salts, the sulphates of potassa, soda, and copper, the nitrates of potassa and silver, the alkaline chlorides, potassa, soda, baryta, strontia, bromine, iodine, and even oxide of lead. It dissolves or suspends the vegetable alkaloids in the same manner as the aqueous liquids, and at the same time the resulting products may be used for the same purposes as though mixed with oil. Thus the salts of morphia dissolve in it completely, even cold, in all proportions. Sulphate of quinine, in the proportion of 1-10th, dissolves in it when hot, but when cold separates in clots, which when triturated with the supernatant liquid give it the consistence of a cerate very useful for frictions and embrocations. It is the same with the salts of brucine, strychnine, veratrine, and most preparations of the same order, which enables us to consider that we have now if not medicinal oils with a vegetable alkaloid base, at least a series of new preparations which will fulfil a perfectly analogous use in therapeutics.”

M. Cap, in his second paper (*CHEMIST*, Oct. 1854), states that he employed glycerine of 28 Beaumé, or containing 88 per cent. of anhydrous glycerine, and speaks of it as a solvent of sulphuret of potassium, and sulphuret of lime, of iodine, iodide of sulphur, iodide of potassium iodide of mercury, of some chlorides, and of quinine, and sulphate of quinine.

In *THE CHEMIST* of February, 1855, Dr. Crawcour, of New Orleans, states that for twelve months past he had been in the habit of using glycerine very extensively in those cases requiring cod liver oil, in which the nauseous taste of the latter medicine rendered its exhibition impossible, and that now, in his practice, it had entirely superseded cod liver oil.

In a paper read at the meeting of the Royal Institution of 30th of March 1855, by the Rev. John Barlow, F.R.S., (*THE CHEMIST*, June, 1855) attention was again drawn to the great preservative power of glycerine upon meat. On this occasion Mr. Barlow showed specimens of flesh which had been immersed, some partially and some wholly in glycerine, for more than a month. I can answer for the flesh having appeared to be perfectly fresh.

M. Cap worked upon the waste liquors of soap and stearic candle works, which liquors he had first to concentrate. His process was shortly this:—he used sulphuric acid to separate the lime, and continued boiling and agitation to drive off the volatile fat acids, removing any excess of sulphuric acid by means of carbonate of lime; allowing the liquor to cool at different densities, so as to deposit sulphate of

lime; and, after final concentration, treating and filtering with washed animal charcoal.

M. Cap's process, though an undoubted improvement, was not perfect, as glycerine so purified is always liable to contain more or less of salts of lime. And some glycerine, purified in our laboratory, according to M. Cap's directions, contained in addition volatile fat acids; and though the process was known in this country, specimens of the so-called "pure" glycerine, obtained from the best sources in London so recently as last January, contained in every case more or less impurity.

The best specimen came from Edinburgh; but even this was not absolutely free from impurity. Some medical men appear to have been afraid to prescribe glycerine for internal use, sometimes with reason, as appears from THE CHEMIST of May 1855, where Mr. Hamilton, of Liverpool, referring to the papers of M.M. Cap and Garot, and of Dr. Crawcour, stated, that no doubt the glycerine purified and used by them might be safely used internally; but that having doubts about the purity of glycerine commonly sold as "pure glycerine," he had procured samples from several of the most respectable chemists in Liverpool, and on examination had detected lead in considerable quantity, and that the specimen in which he detected the largest quantity of lead was labelled "pure glycerine," was sold at double the price of the common glycerine, and was warranted free from lead.

I will now proceed to describe the new process for obtaining and purifying glycerine, and may remark that the road by which we arrived at pure glycerine was a rather circuitous one. Our first step was to do away with the lime process of saponification, and with it our only source of impure glycerine. By our first improvement in separating the fat acids from neutral fats, the glycerine was decomposed by the direct action of concentrated sulphuric acid at a high temperature; and all that remained of it was a charred precipitate. A new process for decomposing neutral fats by water under great pressure coming under our notice, led us to look again more closely into our old distilling processes; and the doing this showed, what we had often been on the brink of discovering, that glycerine might be distilled.

In our new process the only chemical agents employed for decomposing the neutral fat, and separating its glycerine, are steam and heat; and the only agents used in purifying the glycerine thus obtained are heat and steam: thus all trouble from earthy salts or lead is escaped.

Distillation, however, purifies the impure glycerine of the old sources.

On the table is a series of products of palm oil, which will serve to illustrate the process. Steam, at a temperature of from 550° to 600° F., is introduced into a distillatory apparatus, containing a quantity of palm oil. The fatty acids take up their equivalents of water, and the glycerine takes up its equivalent; they then distil over together. In the receiver the condensed glycerine, from its higher specific gravity, sinks below the fat acids. Sufficient steam must be supplied, and the temperature regulated, otherwise the elements of the glycerine do not

take up their equivalent of water, and acroleine is evolved,—a body of a very different character, an acrid eye-inflaming vapor, appreciated only by those who have had the misfortune of an experimental acquaintance with it.

In an ordinary apparatus the glycerine distilled from the neutral fat is not in a sufficiently concentrated state for most purposes; it should therefore be concentrated, and, if discolored, be redistilled. It is then obtained, in the state of the specimen on the table, at the temperature of 60° F.: it is of sp. gr. 1.240, and contains 94 per cent. of anhydrous glycerine. It can be concentrated to sp. gr. 1.260, or to contain 98 per cent.

I have now to mention some uses for glycerine which I believe to be new, or to which I have seen distilled glycerine applied.

A possible use which appears worthy of experiment is to inject it into the bladder for the purpose of dissolving calculous deposits: from its blandness it should not cause irritation, while, as it is a solvent of urea and phosphate of lime, it might dissolve them when in the bladder. Some of the high authorities have received glycerine for the purpose of the experiment.

The use of glycerine in photography having been suggested, some distilled glycerine has been sent to several of the best photographers and makers of photographic preparations. It was very well received, and considered to promise well, and is still the subject of many experiments; but as yet it does not appear that any great results have been arrived at. It is, however, expected to supersede the honey of Shadbolt's process.

The properties of soothing and keeping moist the skin have caused it to be used upon chapped hands and sun-burnt faces. It has been proposed as a substitute for syrup in preserving fruits. Mixed with alcohol or pyroxylic spirit, it has been proposed by Mr. Warren De la Rue as an economical fuel for spirit lamps.

For some time past, in Edinburgh as in London, it has been used in skin diseases; it is now being tried in some cases of disease of the mucous membrane of the stomach.

We have been informed that in the preparation of several medicines glycerine may be substituted for syrup or sugar, with the effect not only of preserving the medicine in an active state and free from change, but also of very greatly improving its taste. Griffiths' iron mixture has been mentioned to us as an instance of this.

Glycerine appears to give the means of preservation of some objects of natural history without change in their color. This is shown by the specimens of fish upon the table. Our first experiment was upon a brilliantly-colored two pound trout, caught in one of the Perthshire lochs. Immediately on taking it from the water, I poured a quantity of glycerine over it, and wrapped it in a cloth. At night the fish was cleaned and immersed in glycerine. Next day it was again wrapped in a saturated cloth. On examining it a day or two afterwards in Edinburgh the color on the scales was unchanged. When it arrived in London part was steeped in water and then cooked. Though

perfectly fresh and firm, it had lost almost all its flavor; the uncooked portion was immersed in glycerine, and sent to Professor Owen, who suggested that the brilliantly-tinted fishes of the Coral Islands and tropical coasts might be brought home in kegs of glycerine.

On the table are specimens of trout, roach, and perch, which have been, the trout more than two months, the perch and roach more than one month, in their bottles; it will be seen that the colors continue bright.

I may now state in conclusion, that though a variety of uses, actual and possible, for pure glycerine have been mentioned, yet when we consider its power as a solvent, and at the same time its blandness, and freedom from all irritant, exciting, acid, and fermenting properties, we must feel that not a tithe of its uses have yet been developed; that in glycerine there is a wide field open, requiring many scientific and practical laborers, and which, once fully worked, will yield a tenfold crop of uses. Pure glycerine will then take its proper place among the most valued of modern products; and, produced, as it will be, in great quantities, it will be recognised in the Arts as well as in Medicine as a new, real blessing to mankind.

On a NEW MODE of PREPARING RED OXIDE of IRON ("ROUGE") for POLISHING GLASS and METALS.

By M. A. VOGEL, jun., of Munich.

WE ordinarily use for polishing glass and metals, red oxide of iron (*colcothar, caput mortuum vitrioli*), which is procured in various ways, either by heating sulphate of iron alone or previously mixed with common salt, or by several other means. All these processes have, however, the inconvenience, that it becomes indispensable to wash the powder for a long time, in order to separate the finer from the coarser and harder parts. Even by long continued washing, it is difficult to arrive at absolute security in using it, without running the risk of wasting the labor of several weeks, in consequence of the remains of coarse parts which have not been separated, notwithstanding the long washing. Therefore, a *colcothar* capable of being employed with safety is always in great demand and of high price.

These circumstances have induced me to seek a new process for procuring a *colcothar* which should be preferable to that prepared in the ordinary manner, however carefully washed.

Numerous experiments have shown me that the decomposed oxalate of protoxide of iron presents the proper means for accomplishing this object.

The oxalate of protoxide of iron heated in a close vessel out of contact with the air, gives iron pyrophorus, that is to say, metallic iron so finely divided that it inflames on contact with the air, and red oxide of iron is formed. This transformation takes place very rapidly, when we heat the oxalate of protoxide of iron in the air on a sheet of platinum, during which operation the matter undergoes a considerable augmentation of bulk.

Owing to the carbonic acid and carbonic oxide gases which are disengaged at this high temperature, the substance is thoroughly divided, and during this disengagement of gases, it absorbs oxygen from the air. We have consequently, in the disengagement of gases and in the absorption of oxygen, a means of reducing the oxide of iron to the state of as fine a powder as possible.

In order to procure colcothar according to the mode indicated, we operate in the following manner; into a solution of sulphate of iron made with boiling water and filtered, we pour a concentrated solution of oxalic acid, until no more yellow precipitate of oxalate of protoxide of iron is formed. When the liquid is quite cold and deposits nothing more, the precipitate is washed on a cloth with hot water until the washing water no longer gives an acid reaction.

The oxalate is afterwards heated in the partially dry state on an iron plate or in a boiler of the same metal, over a small charcoal fire or even a spirit lamp. The decomposition commences at the temperature of 200° C. (392° F.) and on raising the temperature a little, the red oxide of iron is formed, and is found in the finest possible state.

The colcothar formed by this mode affords perfect security of the finest division of the product, and may be employed with the greatest success for polishing plate glass and the glasses used by opticians, without any previous washing.

The trials which have been made of this colcothar, in the arts, for polishing metals, principally gold and silver, have demonstrated that the finest polish may be obtained without even scratching the surface, therefore it may be employed for polishing Daguerreotype plates, telescopes and other objects of that kind. Moreover artizans have found that, by employing this colcothar the operation of polishing glasses is very greatly accelerated.

Journal de Pharmacie, July, 1854.

NEW MODE of PREPARING OXIDE of TIN for POLISHING METALS and GLASS. By M. VOGEL, jun., Professor of Chemistry at Munich.

SOME time ago, I described a new process of making red oxide of iron (see the foregoing article). This rouge has now become an article of commerce, because it does not require the repeated washings of ordinary rouge, and because it gives, in the opinion of artists, a more expeditious and more certain means of polishing than any other substance hitherto employed.

The new process which I described for the preparation of the red oxide of iron is applicable to the oxide of tin.

Numerous enquiries addressed to me on this subject have induced me to resume my experiments, of which I here give the results.

We obtain, as is known, by pouring a solution of oxalic acid into a solution of chloride of tin, a white precipitate of oxalate of protoxide of tin. It was of this fact that I availed myself for obtaining, according to the following method, an absolutely pure oxide of tin in such a

state of extreme division that it may, without washing, be employed directly for polishing glass and metals.

A solution of commercial chloride of tin is prepared by pouring on one part of the salt, six parts of boiling distilled water, and the solution is filtered through a cloth into a cylindrical glass vessel, in order to allow the foreign substances which are sometimes found in the chloride of commerce to deposit. The filtration by means of filtering paper is too slow, and it is always attended with the loss of a subchloride which does not pass through filtering paper; therefore, this filtration is not practicable, and may be completely replaced by passing the solution through linen.

Into the still hot and almost clear solution of chloride we pour a concentrated solution of oxalic acid; a white precipitate of oxalate of protoxide of tin is formed. After complete cooling, the liquor is decanted, and the precipitate is washed on a cloth with cold water until the washing water has no longer an acid reaction.

The oxalate of tin is afterwards heated, dried on an iron plate or in a boiler of the same metal, over a small charcoal fire. The decomposition of the salt commences at red heat, and there remains, after the disengagement of carbonic acid gas and carbonic oxide, a quantity of oxide of tin which is found in the state of extreme division.

During the decomposition, which must be accelerated by stirring with an iron wire, the matter undergoes a considerable increase of bulk, consequently, it is necessary to employ for this operation very spacious vessels, so as to avoid loss of product.

With regard to the quantity of the substances, it results from calculation, that we obtain one part of oxide of tin by employing two parts of chloride of tin and one part of oxalic acid.

The trials which artizans have made of this oxide of tin for polishing metals, principally objects of steel and optical glasses, have proved that this product occurs in the finest possible state of division, and that it presents great advantages in its application; thus, I have no reason to doubt, after this first success, that the oxide of tin obtained by the process indicated will be generally introduced into industry.

Journal de Pharmacie, September, 1855.

MANUFACTURE of CINNABAR at IDRIA. By M. HUYOT.

THE process commences with the preparation of the black sulphuret of mercury. For this purpose, 42 lb. of mercury and 8 lb. of sulphur in coarse powder are introduced into a cask, which receives by machinery a reciprocating rotatory movement, at the rate of from fifteen to twenty-five rotations per minute. The length of time during which the mixture remains in the casks varies from 23 to 35 hours, according to the temperature. The combination of the materials is not complete, for particles of sulphur and globules of mercury may still be detected on it, and here and there it acquires a reddish tint from incipient conversion into cinnabar. The mass is then introduced into cast-iron retorts, of which there are twenty-four, arranged in four furnaces. Each

retort is furnished with an earthenware head, connected by a tube with a receiver. The heads being adjusted, and properly luted, heat is applied, and the temperature raised to 259°. As soon as sulphureous vapors appear, the tube and receiver are attached, and at the temperature of 716° sublimation goes on with rapidity. The retorts require about two-and-a-half hours to reach the temperature at which sublimation commences, and the charge is sublimed in about five hours. Of every 1000 parts of sublimed cinnabar, 365 are found in the part of the head next the retort, 327 in that nearest the tube, 255 in the tube itself, and 53 in the receiver. The cinnabar is then ground by passing it between stones placed at different distances apart, according to the fineness of the grain required. Chinese cinnabar is ground twice, dark red four times, and bright red cinnabar five times.

The product is then refined, as it is called, in order to remove the excess of sulphur employed in the first process. For this purpose it is digested with a ley of wood ashes concentrated until it has a density of 12 B. The cinnabar is then repeatedly washed, and dried on iron plates.

Edinburgh New Philosophical Journal.

PHYSIOLOGICAL & PATHOLOGICAL CHEMISTRY.

On a NEW GLUCOSIC DISEASE, and on MORBID GLUCOGENIA in general.

By Sig. MARIANO SEMMOLA.

AFTER the brilliant physiological discoveries concerning the origin of the sugar in the animal organism, the old theories concerning diabetes not being sustainable, we are naturally led to study this disease under other points of view, and to determine especially the degrees to which the physiological mechanism of glucogenia might elucidate the pathological question. But the very exceptional part played by glucose, and the discovery of new examples of saccharine effusions, very soon showed how complex was the problem, and rendered its solution each day more difficult.

In the mean time, without concealing from ourselves the possible chances of failure, we endeavored to enter upon the question in a twofold point of view. To refer to well determined conditions the appearance of glucose in the urine, in the various morbid states, and to find an experimental starting point for demonstrating the pathological theory which should flow from it, these are the two objects which we proposed to ourselves to try to attain. It is scarcely necessary to say that, in order to accomplish the first part of our work, it was sufficient to pursue the analyses of certain animal liquids, controlling the effects in several ways, and especially employing polarimetry when the quantity of the liquid allowed it.

It was not so easy to seize the second point of our project. However, it seems to us very evident that we might be led to a decisive result by the following reasoning:—

Glucose, secreted by the liver, is destroyed in the economy like all the other hydrates of carbon, and is converted into water and carbonic acid. There is a constant relation between the destruction of glucose and its secretion. Every organism has a limit of activity of combustion, and, for that purpose, must have a corresponding limit in the glucogenic activity; then the estimation of the vapor of water and carbonic acid exhaled may furnish a very exact measure of the quantity of glucose secreted; and in the same way we may learn whether sugar appears morbidly out of the organism, in consequence of the exaggeration of the hepatic activity, or else of the respiratory function.

To realise these determinations, we employed a very simple apparatus, by means of which we could, at the same time, estimate the quantity of carbonic acid and expired steam, and the proportion of oxygen left in the expired air. We should renounce the determination of the volume of air inspired, because several experiments have demonstrated to us that the respiration was always more or less constrained when the volume of air which should serve for its maintenance was limited, and for that purpose we obtained comparatively a very sensible diminution in the quantity of carbonic acid exhaled. It was in pursuing these studies, that we had occasion to observe this new glucosic malady, of which the description and researches constitute, in great part, the subject of the Memoir which we have the honor of presenting to you. We do not think that hitherto medical history has presented so remarkable an example, or so well defined, of saccharine perspiration, as that of which we treat. This strange modification of the cutaneous secretion occurred in a young man, aged 25, who had been in good health up to the commencement of the disease. It had begun slowly, accompanied with progressive weakness of the legs, continual emaciation, and very abundant perspiration. Increase of appetite, unusual thirst, diminution of urine, slight disturbance of the sight, and finally a kind of shooting pain from the occiput to the first vertebræ of the back, constituted the rest of the symptoms.

Our attention was first attracted, and we were thus led to the discovery of sugar in the perspiration, by the consistence acquired by the sheets moistened by the perspiration and afterwards dried. From this moment we commenced a series of very minute researches on the changes and relations of a functional disturbance so similar to diabetes. We regret that the necessary brevity of this extract forces us to omit the very curious details of this history in a clinical point of view; however, we may mention that, after almost inevitable failures, the patient was completely cured by the employment of large doses of sulphate of quinine. The following conclusions embody the results obtained:—

1. The quantity of perspiration amounted in an hour to 70 grammes, or 1680 in the 24 hours.
2. The quantity of glucose contained in the perspiration was on the average about twenty thousandths, being at its maximum during the night, and at its minimum in the morning. An exclusively nitrogenous

diet, or the employment of some feculent matter, did not materially alter its proportion.

3. Chloride of sodium was also diminished in quantity, so as almost to lead one to doubt its existence. The greatest quantity I obtained in seven analyses was 0.095 from 69.23 of perspiration; that is to say, 1.37 gr. in 1000 grammes. It is also remarkable that its proportion was found to be apparently in inverse ratio to the quantity of glucose.

4. The perspiration contained a considerable quantity of free lactic acid.

5. The perspiration of the patient, artificially excited by M. Fabre's* apparatus, six weeks after cure, did not contain the least trace of glucose, and presented almost a physiological composition.

6. The quantity of urine passed in the twenty-four hours was, considered absolutely, very much less than in the normal state, and very much less in quantity than the liquids drunk; this was doubtless owing to the increase of the cutaneous secretion.

7. The density of the urine, owing to the smallness of its quantity, was higher than the healthy average; it had scarcely any relation to the quantity of drink taken; and, on the contrary, it increased or diminished in the ratio of the nature of the diet, and for that reason in the ratio of the quantity of the principles excreted.

8. The quantity of urea was, as usual, rather increased by animal diet, and, probably, still more in relation to the concentration of the urine. Indeed, it never much exceeded the physiological average, not having amounted to more than 22 grammes in 24 hours.

9. The quantity of salts fixed and undecomposable at a red heat was doubtless larger than in the normal state, especially as regards chloride of sodium. In the 24 hours, the patient passed on the average 11 grammes of mineral matters, which contained about 8 grammes of chloride of sodium.

10. Glucose was not a constant constituent, and it evidently had some relation to the quality of the diet. The administration of feculents rendered the urine saccharine in a few hours, and the sugar continued several hours after the last mixed meal. An exclusively nitrogenous diet caused the sugar to completely disappear from the urine.

11. The analysis of the urine repeated several times after the cure, never showed the least trace of sugar, even when the diet contained much feculent matter.

12. In the course of the disease, the quantity of aqueous vapor exhaled was on the average 20.42 gr., and that of carbonic acid expired about 29.72 gr. per hour. At this moment, the mean relation between the weight of the body considered equals 1000, and the quantity of carbonic acid expired may be represented by 0.531 gr.

13. In the state of cure, the same subject passed by the pulmonary surface 32.72 gr. of carbonic acid, which constituted a relation with the weight of the body increased by 9 kilogrammes, of 0.495.

* M. Fabre's Researches on the Chemical Composition of the Perspiration of Man, will be found in *THE CHEMIST* for 1852-3, vol. iv. of the last series.

14. The proportion of oxygen in the air expired was, on the average, during the disease, about 16·8 gr. per 100, and it remained nearly equal in the return to the physiological state.

15. The quantity of carbonic acid expired, during the disease, varied periodically during the 24 hours, apparently in the inverse ratio of the activity of the cutaneous functions.

16. Very considerable variations also occurred in the quantity of carbonic acid expired, in the ratio of the quality of the diet.

It was by comparing these results with those which we obtained in two cases of glucosuria, and after having examined the numerous examples which physiology and pathology present of saccharine effusions that we were led to establish:—

1. That there is a double series of sacchariferous diseases: one depending, unquestionably, on the exaggeration of the glucogenic activity of the liver, without the work of combustion falling below its normal rate, and the other, on the contrary, manifesting itself very probably in consequence of a deficiency in the oxidising activity of the respiration, without the quantity of sugar secreted having increased.

2. That the duration of these morbid states, and the quantity of sugar eliminated constitute very decided characters of the two different origins which we have mentioned. Indeed, it is evident that the increase in the secretion of sugar has nothing in it incompatible with life, producing only, in a long time, the ordinary consequences of consumptive diseases; whilst an alteration of the respiratory function which should render it insufficient for destroying the normal sugar could not long be reconciled with the accomplishment of the functions necessary to life. The example which we have just studied, and all true cases of glucosuria, enter into the first series; saccharine effusions, which happen in the sequel of epilepsy, and, I think, of certain other neurotic diseases, constitute very clear cases of the second.

Comptes Rendus, No. 11, Sept. 10, 1855.

THIRD MEMOIR *on the GLUCOGENIC FUNCTIONS of the LIVER.*

By M. L. FIGUIER.*

THE physiological theory which ascribes to the liver the functions of secreting sugar, reposes entirely, as has been declared from the very commencement of this discussion, on the absence of sugar from the blood of the *vena-porta* of an animal digesting meat. The author of this theory declares, in conformity with his previous works, that “in an animal, digesting cooked or raw meat, there is no sugar in the *vena porta*, either one, two or three hours, &c., after the meal.” On the other hand, I have affirmed, relying on more than thirty experiments, made on dogs submitted to an exclusively meat diet, and bled

* For the first two Memoirs of M. L. Figuier, see THE CHEMIST. vol. ii. of the present series, 1854-5, pp. 346 and 561. See also in the same vol. Memoirs on this subject, Lehmann, p. 487; M. Cl. Bernard, p. 490; Poggiale, p. 615; Leconte, p. 618; Moleschott, p. 692.

from the *vena porta* during digestion, that we may always, by means of Frommhertz's test, recognise the presence of a saccharine principle in the blood of the *vena porta* of an animal placed in these conditions.

The Academy confided to a commission the task of judging of these contradictory facts, in order to terminate this discussion, and to settle the opinion of physiologists on a question which had attracted much notice in the scientific world. At the sitting of the 18th of June, the Academy received the report of the committee (for which see THE CHEMIST, vol. ii. 1854-5, page 689.) Conformably to the facts which I had the honor to exhibit to it during the experiment to which I was summoned, the committee recognised that there exists in the blood of the *vena porta* of an animal which has taken a meal of meat, a principle which reduces Frommhertz's liquor, that is to say, tartrate of copper dissolved in potassa. But it adds that to its eyes this phenomenon of reduction is insufficient for characterising sugar, and that fermentation alone can furnish an accurate conclusion as to the nature of this principle. Acknowledging that the question relative to the secretion of sugar by the liver was not yet solved, the committee was kind enough to enjoin those who are occupied with experiments on this subject, to continue their investigations.

I have conceived it to be my duty to obey the wish expressed by the eminent reporter of the committee, and I now communicate to the Academy the result of my new experiments.

Chemistry has made us acquainted with a great number of substances which, added to a saccharine liquid, have the property of opposing the action of the ferment. But it is sufficient to make these products disappear, by means of an appropriate reagent, to see the alcoholic fermentation, hitherto impeded, immediately manifest itself. It is a fact of this kind which occurs with regard to the sugar contained in the blood, conveyed by the *vena porta* during the digestion of meat. This principle does not ferment directly, but it is sufficient to boil it for two or three minutes with a dilute acid, that is to say, with a few drops of sulphuric or nitric acid, and afterwards to saturate the acid accurately by an alkaline carbonate, for the alcoholic fermentation to be manifested by means of beer-yeast added to its solution.

The experiment which we are going to detail will put this phenomenon in its true light.

A dog of large size, which had been fed for eight days on horse-flesh, took a meal composed of this meat cooked. Six hours and a half after this meal, the ligature of the *vena porta* was effected in the living animal, by operating as I have pointed out in my second memoir; the blood, defibrinised, weighed 700 grammes. 600 grammes of this blood were treated with two and a half times their volume of alcohol of 36 degrees. Separated from the red coagulum due to the action of the alcohol, and acidulated with a little acetic acid, this liquor was evaporated to dryness on a sand bath. The residue, when quite dry, was treated in distilled water, and passed through a cloth, in order to separate it from the albuminous deposit formed during the evaporation.

The liquor thus obtained was divided into two equal parts. The first part was put directly, and without any peculiar treatment, in contact with beer-yeast: it gave no sign of fermentation. The second was kept boiling, for two or three minutes, with five drops of ordinary nitric acid. The liquor, which was turbid and passed with difficulty through the filter, gave by ebullition a deposit of albuminous or caseous nature, and it suddenly became clear, assuming a beautiful yellow tint. Afterwards neutralised *very accurately* with a little carbonate of soda in powder, and put in contact with well washed beer-yeast, it gave, after a quarter of an hour, signs of fermentation, which continued for several hours. The gas collected was entirely absorbable by potassa. As to the liquid, it was placed in a small retort, and about one-fifth of it was collected by distillation. During this distillation it was easy to recognise, in the receiver in which the vapors were condensed, a well characterised odor of alcohol. The product of this distillation having been placed in a smaller retort, it was rectified so as to collect only the first seven or eight drops of the product. In this rectification the alcoholic odor was evidently manifested. Finally, this last liquid, with the addition of a few drops of a solution of bichromate of potassa, and treated with a little sulphuric acid, and then boiled, assumed a green color, and retained, after boiling, a slight odor of aldehyde.

The foregoing experiment was repeated several times, with this difference, that we did not divide into two parts the liquid which was devoted entirely to establishing the phenomenon of fermentation, owing to the previous ebullition with a few drops of sulphuric or nitric acid. In all the experiments executed in this manner, by acting on from 3 to 400 grammes of blood of the *vena porta* of dogs submitted, for at least a week, to nourishment with horse-flesh alone, and drawn from five to six hours after the meal, we always obtained the same results as above related.

I discuss, in the memoir of which this is an abstract, the process which has hitherto been employed for the comparative search for sugar in the blood of the *vena porta* and in that which issues from the liver. I show, by this discussion, that the process which consists in killing the animal and taking the blood in the hepatic veins, that is to say, in the very midst of the saccharine tissue of the liver, is vicious. I afterwards sum up the new facts which I have put in evidence in the course of the various researches which I have communicated to the Academy. I terminate my work by recapitulating the general considerations, resulting from works already known, which are likewise opposed to the existence of the glucogenic function. These considerations are the following:—

The object of the glucogenic function would be to create a single product; which product, once arrived in the blood, no one could say what would become of it, nor how it would disappear.

The theatre of this function would be the liver. But this organ is already the seat of a secretion which has nothing mysterious or hidden about it; that of the bile. The blood which is introduced into the

liver does not contain the elements of bile, and this product, secreted at the expence of the blood, escapes from it by means of an excretory canal. On the contrary, the blood which penetrates into the liver, always contains a certain quantity of sugar, and we do not yet know of any excretory duct for the saccharine principle. Moreover, we find in the liver only one kind of cellule, which indicates that this gland, like the other glands of the system, is anatomically organised for only one secretion.

The appearance of glucose in the liver is always subordinate to the alimentary regimen. In a well-fed animal, it is always during digestion that the proportion of sugar in the liver is most considerable, But if we suppress the alimentation, we see this product rapidly diminish in the liver, and it ultimately disappears in consequence of prolonged abstinence. Certainly, at other conjunctures, such a fact would of itself have sufficed for proving that in the animal economy sugar is a simple product of digestion, and not the result of a physiological secretion. Add to this the confirmatory fact that, according to M. Andral, diabetic patients, when dieted, cease to pass sugar by the urine, which proves that in the state of disease, as in the healthy state, the appearance of sugar is subordinate to the alimentation.

The presence of sugar in the liver does not appear to be in any way dependant on the nervous system, as are all the other functions of the system. That demonstration of the influence of the nervous system on the glucogenic function, which consists in showing that sugar appears in the urine of the rabbit in consequence of the puncture of a certain particular point of the *medulla oblongata*, has, in this discussion, no signification. It is, indeed, well ascertained, from recent researches, that in this experiment the sugar appeared in the urine only in consequence of the disturbance occasioned by the lesion of the central nervous system in the assimilation and destruction of the sugar in the economy.

Comptes Rendus, No. 9, Aug. 27. 1855.

On the MECHANISM of the FORMATION of SUGAR in the LIVER.

By M. CLAUDE BERNARD.

THE glucogenic function of the liver is one of those which have had the distinction of most powerfully attracting the attention of physiologists, chemists, and physicians, owing to the importance of the ideas which it raises in general physiology.

After having, by numerous experiments made on man and animals, established the generality of this new function, and after having studied it in its physiological conditions, and localised in the liver, I must enter further into the nature of the phenomenon, and endeavor to penetrate the intimate mechanism of the production of sugar in animals.

The new experiments which I now submit to the Academy are destined, I think, to throw much light on this interesting portion of the subject.

It would be useless for me to reproduce here all the indisputable facts by which I have established the reality of the glucogenic function. For six years these facts have occupied their place in science, and I must congratulate myself on having seen them confirmed in all countries by the most competent chemists and physiologists.

Nevertheless, as lately some authors have introduced inaccurate experiments into the question of the production of sugar in the animal organism, I have thought it necessary, before entering into the matter, to dispel those inaccuracies by re-establishing in their order, and, in a very succinct manner, some of the fundamental facts which serve as the basis of the glucogenic theory.

Firstly. I have said in my memoir that there exists in animals a physiological function by virtue of which saccharine matter is produced in the organism, because sugar always persists in the liver and in the blood of carnivorous animals whose diet contains no saccharine substance. This is a capital fact; for, a short time ago, it was generally admitted that the sugar found in the organism was always introduced as such by the diet. No one any longer discusses this question, and it remains perfectly established, since my experiments, that sugar (glucose) is produced in the animal organism without the intervention of saccharine or amylaceous substances.

Secondly. I have likewise said that this glucogenic function must be localised in the liver. Indeed, in a carnivorous animal, the liver is in reality the central point from which the sugar sets out in order to spread itself throughout the body, and, which is a circumstance on which I have particularly insisted, the blood which penetrates into the liver by the *vena porta* does not contain sugar, whilst the same blood which issues by the hepatic veins always contains considerable proportions of it. We could not help concluding from this that sugar is formed in the liver, the tissue of which is, moreover, constantly impregnated with saccharine matter in the physiological state.

This experiment, which will always constitute one of the principal chemical arguments in favour of the glucogenic function of the liver, has hitherto met with only one contradiction. The author of these contradictions has recently read before this Academy three successive memoirs intended to deny the glucogenic function in animals.

In his first memoir, the author also maintained that sugar cannot exist in animals without a saccharine or amylaceous diet; and in order to explain the presence of sugar in the liver and blood of carnivora, he said that the meat produced from herbivorous animals must always contain sugar. This is an assertion utterly at variance with experience; for neither the author nor any one else has ever proved the presence of sugar in meat.

In his second memoir (see the CHEMIST, present series, vol. ii. 1854-5, page 561), the author admits that which he has denied in the first, and he acknowledges that sugar is produced in animals without the intervention of a saccharine or amylaceous regimen; but he then tries to prove that sugar, instead of being formed in the liver, is only condensed or accumulated in it. He supposes that the saccharine

matter, being produced in the blood, passes by the *vena porta* and is deposited in the hepatic tissue. According to this idea, the author has been led to admit not only that there is sugar in the blood of the *vena porta*, but he has been compelled to reverse the results of the experiment as I had found them; thus he writes in his memoir that in an animal fed with raw meat there had been found, two hours after the meal, a greater quantity of sugar in the blood of the *vena porta* than in the blood of the hepatic veins.

The author, having the opportunity of repeating this experiment before a committee of the Academy, found it absolutely impossible to show the presence of sugar in the blood of the *vena porta*, and the committee has declared that in a carnivorous animal, during the above-mentioned digestive period, and by means of alcoholic fermentation, the only positive indication of the presence of sugar, it had not demonstrated sugar in the blood of the *vena porta* in an appreciable manner, whilst it had found considerable quantities in that of the hepatic veins. In conclusion, also, the committee acknowledged the error of the results which had been put forward, and re-established the facts as I had seen them, as well as all those who have repeated them after me.

More recently, in a third memoir (see the preceding article, p. 111) the same author pretends that the reason of his not having shown the presence of sugar in the blood of the *vena porta* was that there exists in it an unknown matter which disguises the presence of sugar by opposing fermentation; and he describes on this subject experiments in which he states that he rendered this sugar evident by destroying this undetermined matter which concealed it, by means of boiling with sulphuric or nitric acid. I have tried this experiment, according to his directions, and after having carefully repeated it several times, I must declare that the facts advanced are utterly incorrect. The blood of the *vena porta*, collected in suitable conditions, does not ferment even when it has been boiled with an acid, as stated by the author. But when we placed ourselves voluntarily afterwards in the conditions in which sugar might be found in the blood of the *vena porta*, which conditions I had determined long ago, then we directly effected the fermentation, without requiring any previous treatment by an acid; and that which was sufficient to prove that this pretended matter opposed to fermentation does not exist, is that, by adding a small quantity of a saccharine solution to the blood of the *vena porta* with beer yeast, fermentation was very readily set up.

The experiments which serve as the basis of the several memoirs which I have just quoted being incorrect, there is no occasion to deal with the physiological errors and all the contradictions into which the author has necessarily fallen in consequence of such a starting point.

I therefore immediately pass on to the study of the mechanism of the formation of sugar in the liver which forms the subject of this memoir.

Comptes Rendus, No. 13, Sept. 24, 1855.

(To be concluded in our next.)

BIBLIOGRAPHY.

THE FARMER'S MANUAL OF AGRICULTURAL CHEMISTRY, WITH INSTRUCTIONS RESPECTING THE DISEASES OF CEREALS, AND THE DESTRUCTION OF THE INSECTS WHICH ARE INJURIOUS TO THOSE PLANTS. By A. NORMANDY. Illustrated by numerous Wood Engravings. London: G. Knight and Sons.

IN these days, when the tillers of the soil find themselves compelled to bring scientific knowledge to bear on their pursuit, when a practical acquaintance with chemistry as applied to agriculture is of vast importance to them, a work in which this subject is treated of in a clear yet concise manner, intelligible by an ordinary capacity, will always be regarded as a boon.

The work before us treats of soils of all kinds, their properties, the plants for which they are adapted, and the means of ascertaining their composition by analysis. The analytical processes may be followed by any person who makes up his mind to study the subject, and to acquire practice in chemical manipulation. The composition, modes of analysis, and agricultural value of manures are also given. The diseases of cereals, and the remedial measures to be adopted, will be found very useful, as will the chapter on the insects injurious to cereals, and the means of destroying them.

Dr. Normandy's book will be found of much practical utility to farmers, and we recommend them to place it early in the hands of their sons.

EDINBURGH NEW PHILOSOPHICAL JOURNAL. NEW SERIES. No. IV. Edited by Dr. THOMAS ANDERSON, Sir WILLIAM JARDINE, and Dr. J. H. BALFOUR. Edinburgh: A. & C. Black. London: Longmans & Co.

THE present number of this excellent journal contains a large amount of valuable matter. We may mention as among the principal contents—Dr. Daubeny "On the Influence of the Lower Organisms in the Production of Epidemic Diseases;" "Description of a New Species of Trematode Worm," by Dr. J. S. Cobbold; Astronomical Contradictions and Geological Inferences respecting a Plurality of Worlds;" Mr. R. Davidson "On some New Compounds of Furfurine;" Mr. Galletley "On a New Glucoside in the Petals of the Wallflower" (transferred to our own columns); Dr. T. H. Rowney "On Two Mineral Substances employed as Pigments," (which we have also printed); "A Sketch of the Operations executed in the Drainage of the Lake of Haarlem, with its Present state," by M. Gevers D'Endegeest; "Supplemental Observations on Electric Fishes," by Andrew Murray; with a condensed "Report of the Proceedings of the British Association;" a "Report of the Botanical Society of Edinburgh;" "Miscellaneous Intelligence on the Sciences of Zoology, Geology, Chemistry, Botany, Mineralogy, and Meteorology."

PROCEEDINGS OF SOCIETIES.

BRISTOL MICROSCOPIC SOCIETY.

MAY 9TH.—Professor W. Herapath called the attention of the Society to a peculiar crystalline compound which had been discovered by his son, Mr. Thornton Herapath. The latter gentleman, it appears, has for several years past been engaged in investigating the action which is exerted by certain poisonous substances upon the system, and has tried numerous experiments with opium, haschish, nux-vomica, and phosphorus, the results of which he intends at some future period to communicate to the public. By gradually increasing the dose, he finds, that nux-vomica and strychnia may be taken in very large quantity without producing any injurious effects. Happening accidentally, however, about two years ago, to take an over-dose of nux-vomica, and finding himself attacked by tetanic spasms, he endeavored to counteract the effects of the poison by the internal administration of iodine. Upon afterwards collecting some of his urine, and submitting it to analysis by concentrating it, after the addition of a little sulphuric acid, and then allowing it to cool, he was surprised to find, upon subsequently examining it, several minute dark-green crystals floating on the surface. These crystals, on being collected and examined by the microscope, were found to measure from 1-600th to 1-200th of an inch in diameter, and to consist of several flattened acicular crystals, radiating from a common centre. They closely resembled, in their optical properties, the so-called sulphate of iodo-quinine, (Herapathite of Haidinger) which has been described by Dr. W. Bird Herapath in the *Philosophical Magazine* for 1852 and 1853; or, perhaps more nearly, the crystals described by Mr. Stoddart in the sixteenth number of THE CHEMIST.* Upon further investigation, it was found that the same compound may be formed artificially, by adding an alcoholic solution of iodine, in small quantities at a time, to a solution of the sulphate of strychnine; and chemical analysis

* Mr. T. Herapath has recently informed us that he has succeeded in preparing the compound above alluded to as having been observed by Mr. Stoddart, in the urine of a patient who had been treated with the iodide of iron and quinine, and has arrived at the conclusion that it is not simply composed of iodine, iron, and quinine, as Mr. Stoddart supposes, but is in reality, he believes, an ioduretted sulphate of the peroxide of iron and quinine. The crystals of this singular compound strikingly resemble in form the iodo-sulphate of strychnine, and may be prepared by dissolving the disulphate of quinine in a weak acid solution of the persulphate of iron, and then adding thereto a few drops of a solution of iodine in iodide of sodium. On applying a gentle heat to this mixture, and then allowing it to cool slowly in a closed vessel, the little acicular crystals of the ioduretted compound will make their appearance floating on the surface of the liquid. Some care is required to be taken in the addition of the acid and the solution of iodine, otherwise nothing but crystals of the sulphate of iodo-quinine are formed. They may be also produced, it appears, by substituting the iodide of iron and quinine for the disulphate of quinine in this process; and are distinguished from the sulphate of iodo-quinine by their color and the form of the stellate masses.—Eds. of "THE CHEMIST."

proved that it consisted of iodine, sulphuric acid, and strychnine. Mr. Herapath, however, was prevented from submitting them to a complete ultimate analysis in consequence of being laid up for several months by a series of severe accidents, one of which we had occasion to allude to in the March number of THE CHEMIST.

The sulphate of iodo-strychnine, or ioduretted sulphate of strychnine generally occurs as pretty little stellar crystals, but occasionally it forms four small-sided prisms. It cannot be readily obtained in thin laminæ, and is not therefore applicable to the manufacture of artificial tourmalines. It has a fine green color when examined by transmitted light, but appears semi-metallic and sienna-brown-colored by reflected light.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

(Concluded from page 64.)

On the ACTION of SULPHURETS on METALLIC SILICATES at high TEMPERATURES. By D. FORBES.

THIS communication first treated of the sulphurets of metals formed by fusion, showing that very distinct compounds were thus formed generally more basic than under other circumstances. The action of sulphurets on silicates was illustrated by a series of researches, which showed that when the silicate of a weaker metal was fused along with the sulphuret of a stronger one, or *vice versa*, the result was the same,—not a perfect mutual decomposition, as would have been expected but the production of a double sulphur-salt of both metals. When the fusion, however, took place at lower temperatures no action was found to occur. A series of specimens illustrating the occurrence of such reactions, metallurgical operations and their chemical composition, &c., were shown.

On some POINTS connected with AGRICULTURAL CHEMISTRY. By Mr. J. B. LAWES and Dr. GILBERT.

Dr. GILBERT went into a lengthened defence of his views, which had been attacked by a writer in the *Highland and Agricultural Society's Magazine*. The paper indicated the character of exhaustion by corn-cropping, and the action of manure on different crops.

BARON LIEBIG replied to Dr. Gilbert's theory, in the course of which he recapitulated the views which he recently published on this controversy.

The MARQUIS of TWEEDDALE gave the result of his own experience as a practical agriculturist. By trusting to frost, and the pulverising of the land, he thought they had no use for chemical experiments.

Dr. DAUBENY supported the principles laid down by BARON LIEBIG.

On the CHEMISTRY of the ADULTERATIONS of FOOD.

By Dr. HASSALL.

The paper, which was of considerable length, contained an immense number of cases which had come under Dr. HASSALL's observation of adulterations of food. These have already been published in the Report of Examinators before a Committee of the House of Commons.

A lengthened discussion followed. One gentleman held that there were only two articles of manufacture which were not adulterated.

Prof. GRAHAM and Dr. MACLAGAN, whilst admitting that there were cases of adulteration, were afraid that too much alarm had been raised on the subject. All adulterations were not necessarily pernicious, and caution should be used not unnecessarily to alarm the public mind.

[All adulterations are at least dishonest, and in this we see reason enough for the agitation the subject has lately undergone. Eds.]

On the COMPOSITION of BREAD. By Dr. MACLAGAN.

HE gave the results of some experiments which he himself had made. The amount of moisture in bread was less, and consequently the nutritive value greater, than was generally allowed. The late Prof. Johnstone had stated that a sack of flour produced one hundred quarter loaves. But according to his (Dr. MacLagan's) examination, the sack of 380 lb. gave 94½ loaves of bread; 100 lb. of flour giving 231 lb. of bread. The majority of bakers were of opinion that the sack produced, on an average, 92 loaves, and there was no great discrepancy between this and the result of his own analysis. Unfermented bread contains, of dry flour, 60; moisture, 10; water added by baker, 30. 100 lb. of flour will give 143 lb. of bread, and a sack of flour will yield 100½ quarter loaves of unfermented bread.

BARON LIEBIG made a few observations on a new mode of making bread introduced into Germany. Lime-water had been used in the preparation of the dough, and the loaf was rendered still more nutritive than that made by the common mode.

Dr. PLAYFAIR said the Section were much indebted to Dr. MacLagan for his communication. Much discrepancy existed among analytical chemists on the subject; but he believed Dr. MacLagan had arrived at pretty accurate conclusions.

On the FORMATION of a NEW METALLIC LUSTRE in FABRICS by the PRODUCTION of METALLIC SULPHURETS on their surfaces.

By Professor CRACE-CALVERT,

Professor F. C. CALVERT presented some observations respecting a process which he has discovered for giving a fine and beautiful lustre to woollen and cotton fabrics, called argentine, by Messrs. Akroyd of Halifax, Yorkshire, who are working the patented discovery. The process consists in combining lead or copper with the sulphur, which

enters as one of the elements composing wool; and what adds peculiar chemical interest to this discovery is not only the above fact, but that it is the first instance known of the artificial production of the native sulphuret of lead or galena and that of copper or the copper pyrites. Professor Calvert stated, before describing his process, what gave him the idea of producing the lustre by metallic sulphurets was a fact observed many years ago by his master, M. Chevreul, and certain facts to which Mr. Schischkar, one of the gentlemen at Messrs. Akroyd and Sons, drew his attention. The process consists in combining the wool with a salt of lead or copper, and then submitting the fabric to the action of high pressure steam, saturated with nascent sulphuretted hydrogen. The lustre is then produced by the formation of the sulphuret of lead in that allotropic condition called galena. The fabrics are then washed, dried, and finished for the market.

CONDITION of the ATMOSPHERE during CHOLERA.

Dr. R. D. THOMSON read the following paper on this subject:—

The chemical condition of cholera atmospheres is a question of intense interest on the subject of public health; but with the exception of the unpublished experiments of Dr. Prout in 1832, comparatively little attention appears to have been bestowed on it. One of the most striking circumstances connected with the occurrence of the disease is, that no change, very palpable to the senses, prevails, and even one may have remarked that the weather has usually been exceedingly agreeable. In London, at St. Thomas's Hospital, the neighborhood of which afforded a large supply of cholera cases, the relative weight of the air in Aug., 1854, a cholera month, and in Aug., 1855, when the metropolis was in an extremely healthy condition, is exhibited in the following table, in grains per cubic foot:—

1854. Week ending	Weight of Cubic foot in grains.	1855. Week ending	
Aug. 5.	. . 522.9	Aug. 4.	. . . 516.9
„ 12.	. . 526.7	„ 11.	. . . 524.3
„ 19.	. . 525.	„ 18.	. . . 525.9
„ 26.	. . 523.5	„ 25.	. . . 519.2
Sept. 2.	. . 525.2	Sept. 1.	. . . 523.0
„ 9.	. . 530.3	„ 8.	. . . 531.6
Mean	. . . 525.6		523.5

The result, as deduced from this table, which has been calculated approximately from the barometer pressure and wet bulb thermometer, is analogous to that obtained by Dr. Prout in 1832, as I was informed by himself. Corresponding observations have been made at Greenwich by Mr. Glaisher, and the same conclusions arrived at, from which it would appear that this superior weight of a given bulk of air was not a local phenomenon, but was diffused to considerable distances,

and the character distinguishing Sept., 1854, from the corresponding period in 1855, was the absence of any atmospheric action on ozone-test paper, in the former season, while during the present year the oxidising influence of the air has never been absent at St. Thomas's Hospital. During Sept., 1854, however, when no ozone could be detected in London, its action was sometimes faint and often very strongly marked at Lewisham, near Greenwich. Throughout the same periods the air was exceedingly stagnant, and it has since been observed by Mr. Glaisher, and also at Vienna, that rapid atmospheric movement is pretty constantly accompanied by an oxidising condition of the air. With reference to the chemical composition with atmospheres of inhabited localities, and malarious districts, experiments have usually been conducted on the constitution of the gases which enter into the composition of the air. But the result seems to have thrown little light on the possibility of the production from such causes of any disease characterised by a regular sequence of symptoms. So far as our knowledge warrants, gases can either act only as asphyxiating media by the exclusion of oxygen or as slow or rapid poisons. The cause capable of inducing a disease formed on a peculiar type analogy leads us to infer must be in an organised condition either in a solid form, or in a purely diffused or vaporific state. The fact observed that in malarious atmospheres sulphuric acid speedily becomes black, also points to the propriety of examining the air in such situations with the view of filtering from it solid or condensable matter. In the epidemic of 1849-50 I examined the exterior air of an infected district with this object in view, to the extent of many cubic feet, but the result was comparatively negative, and led to the inference that the examination of large masses of air could alone hold out any prospect of a successful issue. For this purpose air was passed through carefully prepared distilled water contained in Woulfe's bottles by means of a large aspiratory apparatus of the capacity of 16 cubic feet, which was kept constantly in action during the day for several months. Occasionally freezing mixtures were applied to portions of the apparatus, and a tube filled with pumice moistened with sulphuric acid placed near the aspirator completed the series. A range of glass tubes conducted the air from a cholera ward into the aspirator. The ward was 32 feet long, 20 wide and 9 high. The air was drawn from the centre of the ward, near the ceiling; and when the apartment was filled with cholera patients, the air, after traversing several layers of distilled water was speedily charred in the sulphuric acid, and deposited a variety of solids in all the Woulfe's bottles, which could even be detected in some measure by the eye. The objects were described in a diagram, and consisted of blue and red cotton fibres from the dresses of the inmates, portions of hair, wool, fringe, sporules of fungi, abundance of vibriones, or lower forms of animal life, with particles of silica and dirt. In this and all the experiments conducted on the air of closed apartments, the distilled water was rendered strongly acid from the presence of sulphuric and sulphurous acids derived from the products of gas and coal combustion. The distilled water employed in these experiments was boiled for some time previous

to being introduced into the apparatus, and was divided into two portions, one part being placed in a stoppered bottle beside the Woulfe's bottles through which the air was conducted, the sediment, if any, being afterwards examined and compared with that resulting from the experiment. The drawings therefore exhibit only the peculiarities of the air examined. When the ward was partially full, white vegetable epiderm, vegetable cellular tissue, fragments of wood, cotton, linen, vegetable hairs, sponge spicula, minute fungi, spiral vessels, sporules, spore cases, animal epithelium, or globules, and silicious particles, while vibriones were entirely absent, or at least mere traces could be discriminated. This is an interesting result, since in the frost time only 98.6 cubic feet were examined, and of the partially empty ward 240 cubic feet passed through the apparatus. When the ward was empty, cotton fibres, wool, a trace of fungus, with carbonaceous and silicious particles, were alone observable, the amount of air examined being 304 cubic feet. The air external to the ward, and in the immediate neighborhood, afforded, from 560 cubic feet, one cotton fibre, one of wool, a crystalline body, probably a sponge spicula, sporules, beautiful mycelia of fungi in various stages of development, and some carbonaceous matter. The distilled water in this instance likewise yielded strongly acid reaction, produced by sulphur acids. The possible influence of sewer atmospheres predicted interesting results from an examination of such air, and accordingly it was found that the predominating feature of this experiment was animal life in the form of swarms of vibriones in various stages of advancement. The chemical reaction in this case, unlike that in the preceding experiments, was invariably alkaline, due to the evolution of ammonia, from the nitrogenous matters contained in the sewage liquors. These experiments render it sufficiently obvious that organic living bodies constantly surround us in close apartments, and particularly that animal matter under certain circumstances is likewise diffused through such atmospheres. They fail to point out any matter capable of communicating cholera from one individual to another through the medium of the air, and, therefore, are so far important to the public; but they show that foreign animal matter, injurious to health, may speedily be concentrated in certain localities, which will undoubtedly assist in the production and propagation of diseases, in conjunction with meteorological conditions. Pathological investigations, carefully conducted by my colleague, Mr. Rainey, detected in one case an entozoon in the glottis, or upper part of the air passage, the only analogues of which have been found in the substances of the muscle of animals, which would seem to indicate that the germ of this creature had been derived from the atmosphere, or at least directly from external sources. It is intended that these experiments, which are tedious and laborious in their character, shall be extended to other atmospheres, so as to obtain comparative series of views, so to speak, of air modified by the influence of different diseases.

On the PRESERVATION of the POTATO CROP.

By CHEVALIER DE CLAUSSEN.

At the meeting of the British Association in Hull, two years ago, I proposed sulphate of lime as a means of preserving the potato. I have since, by successive experiments, convinced myself that it is entirely efficient. I wet them with water acidulated with sulphuric acid—1 part acid, 500 parts water—and, before they are dry, I throw over them powdered sulphate of lime, or plaster of Paris, by which process they are covered with a thin film of sulphate of lime. If the potatoes are already attacked partially with disease, they must be left from 6 to 12 hours in the acidulated water before the sulphate of lime is used; but in case they are free from disease, a few minutes are sufficient. It is very possible that sulphate of lime, with an excess of sulphuric acid, added to the soil in which potatoes grow, may be useful; but I have not made any experiment to this purpose. I have reason to suppose that chemical combinations in contact with animal or vegetable products have a tendency to preserve them in the same way as the combination of oxygen and zinc preserves iron; and that this is one of the causes why the combination of water with the sulphate of lime preserves potatoes and other vegetables; and that, at the same time, the small quantity of free sulphuric acid destroys the fungus which causes the disease.

On a CRYSTALLINE DEPOSIT of GYPSUM in the RESERVOIR of the HIGHGATE WATERWORKS. By Dr. GLADSTONE.

DR. GLADSTONE laid on the table a piece of the gypsum. The quantity found amounted in weight to 1 cwt. The workmen who discovered the gypsum called it congealed water.

Professor CONNELL exhibited a new hydrometer, invented by himself, by means of which a dew point could be obtained with accuracy.

INDIRECT MODE of determining the PRESENCE of PHOSPHORIC ACID, and on the PRESENT EXISTENCE of PHOSPHORIC ACID in the SILURIAN ROCKS of CONNEMARA. By Dr. DAUBENY.

THE manner in which he made his examination was by taking certain portions of eleven different species of rock, having the soil which covered it entirely removed. The rock was then bruised till it had the appearance of common soil. He had introduced above 22 cwt. into his garden, and raised a crop of autumn grain upon it, and he was thus able to advance a general theory with regard to the presence of phosphoric acid in the rock.

Mr. GILBERT said that the rock would be of little use for manufacturing and agricultural purposes unless it contained at least 50 per cent. of phosphate of lime.

On the MANUFACTURE of IODINE and other PRODUCTS from KELP.

By Dr. F. PENNY.

IN the course of his remarks he stated that the results of some hundred tests showed the quantities of the several ingredients found in kelp to be as follows:—In good drift weed—soluble matter 75, insoluble matter 22, water 3, iodine per ton 14 lb., potash salts 7 cwt. In the inferior drift weed, which had been adulterated with sand and stones, the proportions were—soluble matter 40, insoluble matter 50, water 10, iodine 2 lb., potash salts 3½ cwt. In cut weed, the proportions were—soluble matter 60, insoluble matter 35, water 5, iodine 2½ lb., potash salts 5½ cwt. The average production from a ton of kelp was, from drift weed kelp—iodine 12 lb., muriate of potash 4½ cwt., (80 per cent.), sulphate of potash 2½ cwt. (55 per cent.), alkaline or fished salt 2½ cwt., and refuse sulphur ½ cwt. From cut weed kelp the production was—iodine 2½ lb., muriate of potash 3½ cwt. (75 per cent.), sulphate of potash 2½ cwt. (30 per cent.), alkaline or fished salt 3½ cwt., and refuse sulphur ½ cwt.

DESCRIPTION of DR. CLARK'S PATENT PROCESS for softening WATER, now in use at the WORKS of the PLUMSTEAD, WOOLWICH, and CHARLTON CONSUMERS' PURE WATER COMPANY, together with some ACCOUNT of their WORKS.

By Mr. D. CAMPBELL.

HE said:—According to the author, the process of Dr. Clark for softening water may be applied with advantage to water from the chalk strata, water from the New Red Sandstone, and waters which contain carbonate of lime in solution from any strata. It is briefly described as follows, namely, by adding a quantity of milk of lime to the water, it takes carbonic acid holding carbonate of lime in solution, forms a precipitate of carbonate of lime, throwing down at the same time the quantity of carbonate of lime held in solution by the carbonic acid, and thus renders the water soft. The works and operations for carrying out the process were fully described by diagrams. One peculiar feature in the water after it has been softened, and which was not anticipated by Dr. Clarke when he first took out his patent, is, that it does not show the slightest signs of vegetation, though exposed to the sun and light for upwards of a month, whilst the water before softening cannot be kept above a few days without producing *Confervæ*, and if this be not immediately removed, decay commences quickly, and small insects are soon observed, which feed upon the decaying vegetable matter, and the water soon assumes a bad taste. This is continually the case when the water is kept in large reservoirs, and its removal occasions considerable trouble and expense. The author had endeavored to explain the reason of this marked difference between the unsoftened and the softened water; and he was nearly satisfied that the vegetating principle in the water is more especially

due to the carbonic acid holding the carbonate of lime in solution than to the volatile matter, or, as it is sometimes called, organic matter. The process is applicable to many towns already supplied with water from the chalk and from the New Red Sandstone, and if properly applied will be found to pay the expense of its working, and confer a great boon upon the populations, the enlightenment of whose corporations may induce them to adopt it.

EXPERIMENTS *in the* COMPOUNDS *of* TIN *with* ARSENIC.

By Mr. E. HAEFFELY.

THESE experiments had led to this practical fact, that the danger of using any arseniates in stannates of soda might be obviated by the use of pure stannate of soda alone.

On the EXTRACTION *of* METALS *from the* ORE *of* PLATINUM.

By M. FREMY.

M. FREMY treated of the preparation of osmium, rhodium, and iridium from the residues of the platinum ores. The preparation of osmium according to the old method, is attended with great difficulties and actual danger. M. Frémy proposed to prepare osmium by passing atmospheric air over the residual ore, heated in a porcelain tube. The volatile osmic acid is condensed in glass balloons, and the less volatile oxide of rathenium is found at the extremity of the heated tube. The rhodium remaining in the residual mass is separated from the other metal contained, by chlorine gas at a high temperature.

TITANIFEROUS IRON *of the* MERSEY SHORE.

Dr. EDWARDS, of Liverpool, read a paper on the form of Titaniferous Iron which occurs on the western shore of the Mersey, and gave his analysis of it, by which it appears to contain 13.20 per cent. only of titanic acid, which is its most valuable constituent. It disintegrates from the boulders found on the clay-drift along the shore of Seacombe, and becomes mixed with the sand, from which it is separated by means of a magnet. It also contains alumina, silica, and magnetic oxide of iron; hence it possesses magnetic properties. The mineral does not belong to the series of rocks in the neighborhood of Liverpool, but exists in large masses, and has been carried by drift from the hills of Cumberland.

On ALLOYS.

MESSRS. CRACE-CALVERT and Richard Johnson, of Manchester, read a paper on some interesting alloys, and what gives a particular value to these researches is, that these gentlemen have succeeded in producing a great many new alloys, having a definite chemical equivalent composition, thereby bringing a large class of products, called alloys, into the general laws of the present day chemistry, the law of definite proportions or equivalents.

These gentlemen have succeeded in preparing the following alloys of iron and potassium.

FIRST ALLOY.

4 equivalents of iron,
1 „ potassium.

SECOND ALLOY.

6 equivalents of iron,
1 „ potassium.

These alloys were prepared with the view of solving one of the great chemical and commercial questions of the day, viz. that of rendering iron less oxidisable when exposed to a damp atmosphere. But all the alloys which they have produced up to the present time, with the exception of one, are oxidisable, although some of them contain as much as 25 per cent. of potassium, the most electro-positive metal known, and the one most likely to render iron, in that electro-chemical state, less liable to combine with oxygen. The above alloys of potassium and iron, were remarkable for their great hardness.

These gentlemen have also succeeded in producing two new alloys composed of iron, combined with that most valuable and extraordinary metal aluminium, lately obtained by M. St. Claire Deville; these two alloys are composed as follows:—

FIRST.

1 equivalent of aluminium,
5 „ iron.

SECOND.

2 equivalents of aluminium,
3 „ iron.

The last alloy presents the useful property of not oxidising when exposed to a damp atmosphere, although it contained 75 per cent. of iron.

Messrs. Crace-Calvert and Richard Johnson hope to find, between this date and the next meeting of the Association, a practical method of preparing this desirable alloy, which would render eminent service to manufacture.

The following alloys were also described, one composed of one equivalent of aluminium and five equivalents of copper; one other of iron and zinc, composed of one equivalent of iron and twelve equivalents of zinc, and what is interesting respecting this last alloy is, not only its extreme hardness, but that it is produced at a temperature of about 800° F., it being formed in a bath of zinc and iron, containing fourteen tons of metal, and through which iron wire is passed when coated with zinc or galvanised.

Messrs. Crace-Calvert and Richard Johnson took advantage of having such a large melted mass of metals (zinc and iron), to inquire into the following questions, viz. :—If two metals, when melted together, separate according to their respective specific gravity, or form a homogeneous mass combined in definite proportions.

They consequently analysed three samples taken from the melted bath, one near the top, one in the middle, and one at the bottom. Strange to say, they all presented a different composition, and what is not less remarkable is, that the upper layer contained the largest proportion of the heaviest metal. These three samples offered the following equivalents and definite composition :—

Top	{	1 equivalent of tin,
	11	„ zinc.
Middle	{	1 equivalent of tin,
	16	„ zinc.
Bottom	{	1 equivalent of tin,
	19	„ zinc.

These gentlemen also prepared several alloys of zinc and copper; copper, zinc and tin; and copper, zinc, tin and lead, having definite and equivalent compositions; but as they intend to enter more fully into this subject next year, we shall simply state here, that it would appear from their researches, that by preparing commercial alloys, according to fixed scientific rules, instead of mere routine, they hope to produce for commerce cheaper alloys than those now in use.

The action of acids on these alloys of copper, zinc, &c., presents this curious fact, viz., that although hydrochloric acid acts violently upon zinc and tin, still, in alloys containing these metals with copper, they are not, or are very slightly, attacked by this most powerful acid. Similar results were also obtained with sulphuric and nitric acids.

Professor CRACE-CALVERT then read a paper on the “Action of Sulphuretted Hydrogen on Solutions of the Salts of Zinc,” for which see page 1.

BOOK RECEIVED.

THE ART OF PERFUMERY, and the Methods of Obtaining the Odors of Plants; with Instructions for the Manufacture of Perfumes for the Handkerchief, Scented Powders, Odorous Vinegars, Dentrifices, Pomatums, Cosmetics, Perfumed Soaps, &c. By G. W. SEPTIMUS PIESSE. London: Longmans and Co. 1855. [To be reviewed in our next].

THE CHEMIST.

ORIGINAL COMMUNICATIONS.

On the ELECTRO-CHEMICAL DEPOSITION of METALS.

By ALEXANDER WATT.

(Continued from page 72.)

ELECTRO-DEPOSITION OF BRASS AND BRONZE.

It is much more difficult to deposit an alloy of two or more metals, from their solutions, than one only; and this difficulty becomes greater when we require to deposit, as an uniform alloy, two metals, whose electrical conditions are of an opposite character, as zinc and copper. From a solution consisting of zinc and copper in the proper proportions for forming ordinary brass, it is easy to deposit the zinc alone or the copper alone, by increasing or diminishing the battery power, or by raising or lowering the anode, that is to say, by increasing or diminishing the surface of the anode exposed to a given surface of object to be coated.

The difficulty in regulating all circumstances so that an uniform result might be obtained by the operator and so that the process of electro-brassing might be depended upon, has, in many instances, caused this useful art to be abandoned by the manufacturer.

Many processes of electro-brassing have been published and patented in this country and on the continent, but all of them have the disadvantage of being troublesome and uncertain to manage even though the operator be a person well accustomed to electro-deposition. But I think that several of these processes may be rendered commercially valuable if properly applied, and if the solutions are, in the first instance, prepared with the greatest care, and if always the same electrical power be applied to do a given amount of work; and, lastly, if an uniform surface of anode be at all times exposed to a given surface of work. If, on the other hand, the battery power employed be too weak or too excessive, either the zinc or copper will be deposited alone; and if too great or too small a surface of anode be exposed, the same results will be obtained, and thus the solution will soon lose its uniformity and be spoiled.

In giving the various processes of electro-brassing, I may inform the reader that several of them are patented, and consequently cannot be worked for commercial purposes without the permission of the respective patentees.

I.—De Salzedo's Patent Processes.

1. Cyanide of potassium	12 parts
Carbonate of potassa	610 "
Sulphate of zinc	48 "
Chloride of copper	25 "
Nitrate of ammonia	305 "
Water	5000 "

Dissolve the cyanide of potassium in 120 parts of the quantity of water above specified, and then dissolve the carbonate of potassa, sulphate of zinc, and chloride of copper, in the remainder of the water, raising the temperature to about 150° F. and as soon as the salts are well dissolved, add the nitrate of ammonia, frequently stirring until the latter is dissolved. The solution may now be allowed to stand for a day or two in order that the sediment formed may become precipitated, when the clear liquor is to be drawn off and is ready for use.

2. Cyanide of potassium	.	.	.	.	.	50 parts
Carbonate of potassa	.	.	.	.	.	500 „
Sulphate of zinc	.	.	.	.	.	35 „
Chloride of copper	.	.	.	.	.	15 „
Water	.	.	.	.	.	5000 „

This solution may be made up in the same way as No. 1.

3. Bronzing solution.

This solution is the same as No. 1, excepting that 25 parts of chloride of tin are used instead of the sulphate of zinc.

4. Bronzing solution.

In this solution 12 parts of chloride of tin are employed instead of the sulphate of zinc in the second brassing solution. This latter solution Salzedé works at a temperature not exceeding 97° F.

These solutions are to be worked with a brass anode and with an active battery of two or more cells, for deposition of brass will not take place unless a considerable quantity of electricity of brisk intensity be employed.

The above solutions work tolerably well for a short time, but they soon begin to deposit ununiformly, as, from the nature of the solutions, the anode does not supply them with exactly the amount of metal taken from them by the articles coated.

II. Brass Solution.

Acetate of copper	.	.	.	.	.	5 ozs.
Potash	.	.	.	.	.	4½ lbs.
Sulphate of zinc	.	.	.	.	.	10 ozs.
Liquid ammonia	.	.	.	.	.	1 qt.
Cyanide of potassium	.	.	.	.	.	8 ozs.

Dissolve the acetate of copper, which should be previously powdered, with $\frac{1}{2}$ gallon of water, when add 1 pint of the liquid ammonia, and then dissolve the sulphate of zinc in 1 gallon of water, the temperature of which should be raised to about 180° F. when the zinc is dissolved, add the remaining pint of liquid ammonia to the solution, which should be well stirred immediately in order to ensure its perfect mixture with the sulphate of zinc.

Dissolve the potash in one gallon of water. Lastly dissolve the cyanide of potassium in 1 gallon of hot water, and then mix the ingredients in the following order:—Mix the solution of copper with that of zinc, then add the solution of potash and the cyanide of potassium; the whole should be well stirred together and allowed to digest

for an hour or so, occasionally stirring, when sufficient water to make about 8 gallons of solution should be added.

The above solution must be worked with a brass anode and active battery power; occasionally a little liquid ammonia may be added to this solution and a small portion of cyanide, in order that the anode may be enabled to resupply the solution with the amount of metal taken from it by the work done. I have also found that the addition of a little arsenious acid has improved the character of the deposit by rendering it brighter and less crystalline. It is some time, however, after the addition of the arsenious acid before any effect takes place. I generally apply the arsenic by mixing it with a little strong solution of cyanide of potassium.

III. Russell and Woolrich's Patent Process.

Acetate of copper	.	.	.	.	.	10 lbs.
„ zinc	.	.	.	.	.	1 lb.
„ potassa	.	.	.	.	.	10 lbs.

Dissolve the above in 5 gallons of hot water and add a strong solution of cyanide in sufficient quantity to precipitate the metals and to dissolve the precipitate. The cyanide should be in slight excess, in fact, in working the above, cyanide of potassium must be added from time to time, otherwise the solution will soon get out of order.

The patentees recommend the use of either a brass anode or an anode of brass and an anode of copper at the same time.

IV. Bronze Solution, MM. Brunel, Bisson, and Gauguain's Patent Process.

Chloride of copper	.	.	.	.	.	1 lb.
Carbonate of potassa	.	.	.	.	.	25 lbs.
Sulphate of zinc	.	.	.	.	.	2 „
Nitrate of ammonia	.	.	.	.	.	12½ „

Dissolve the chloride of copper in half a gallon of water; next dissolve the carbonate of potassa in 6 gallons of water. Thirdly, dissolve the sulphate of zinc in half a gallon of hot water, and mix these three solutions together. Lastly, add the nitrate of ammonia, and stir them well together. Add water to make about 20 gallons of solution. This solution is to be worked with an anode of brass and an active battery of two or more cells.

The above solution soon gets out of order; and like M. Salzedé's process, which it resembles very much in every respect, the solution does not dissolve the anode sufficiently to keep the solution in a uniform condition. The anode soon becomes coated with a white insoluble salt of zinc, which soon stops its action, unless it be repeatedly cleaned. I have found that by adding occasionally a quantity of liquid ammonia, much of this defect is overcome, both in Salzedé's and Brunel's processes. It is useful, also, to add cyanide of potassium. The ammonia dissolves the salt of zinc which is insoluble in cyanide of potassium, and the latter keeps the other materials in solution, and dis-

solves the anode (with the ammonia) freely. I have found, when experimenting with the above solution, that I could keep the anode quite clean; in fact, it looked as if it had been recently dipped in nitric acid.

As this solution is generally worked, however, the anode keeps in a very foul condition, till at last as I have before stated, the operation almost entirely ceases.

V. Mr. W. E. Newton's Patented Processes consist in forming solutions for depositing an alloy of copper, tin, and zinc, and also for depositing brass and bronze.

1. Chloride of zinc mixed with chloride of ammonium, sodium, or potassium, dissolved in water.

2. Solution of acetate of zinc mixed with acetate of ammonia, soda or potassa.

3. Saturated solution of carbonate of zinc in a solution of carbonate of ammonia.

4. Tartrate of zinc dissolved in a solution of tartrate of potassa, soda or ammonia, and the patentee adds to 1000 parts of either of the tartrates of zinc, marking three degrees on the salinometer, thirty parts of salammoniac and eighty parts of hydrochloric acid.

5. Citrate of zinc dissolved in water containing an excess of citric acid.

6. Tartrate of zinc dissolved in water containing an excess of tartaric acid.

7. When the patentee requires to make a brassing solution, he adds to either of the above solutions a suitable proportion of a corresponding salt of copper.

8. To make a bronzing solution Newton dissolves the double tartrate of copper and potassa and the double tartrate of the protoxide of tin and potassa, with or without the addition of caustic potassa. He deposits the alloy of zinc, tin and copper, by using a solution composed of these three following substances mixed in proper proportions and distilled in water:—Double cyanide of copper and potassium, zincate of potassa and stannate of potassa; the zincate of potassa is formed by fusing oxide of zinc with caustic potassa, and the stannate of potassa either by fusing oxide of tin with caustic potassa, or by dissolving it in a solution of potassa. He also uses the three following substances, mixed together in suitable proportions, and dissolved in water, viz. the double tartrates of copper and potassa, of zinc and potassa, and tin and potassa.

9. For electro-brassing Mr. Newton employs a solution composed as follows:—Dissolve a given quantity of oxide of copper in a solution of cyanide of potassa, allowing the cyanide to be in excess; then add oxide of zinc or other salt of zinc, and lastly a little liquid ammonia is to be then added and the solution raised to the temperature of 120° F. to 140° F. Water should be added in sufficient quantities to allow the solutions to contain about 3 ozs. of the metallic oxides to the gallon; *i.e.*, 2 ozs. of zinc to 1 of copper to form ordinary brass.

VI. Messrs. Morris and Johnson's patent processes—consist in dissolving

1. Cyanide of potassium	1 lb.
Carbonate of ammonia	1 „
Cyanide of copper	2 ozs.
Cyanide of zinc	1 „

in one gallon of water. The temperature of the solution should be raised to 150° F.

2. Cyanide of potassium	1 lb.
Carbonate of ammonia	1 „

Dissolve in one gallon of water. Attach a large brass anode to the positive wire of a battery and apply a small surface of the article to be coated, or cathode, to the negative wire. The temperature of this solution should also be 150° F. Shortly the cathode will become well coated with brass, and by this arrangement the solution will become charged with the metals, zinc and copper, from the anode. By increasing the amount of cyanide of potassium or carbonate of ammonia in the solution the deposit may be rendered redder or more yellow, according to the desire of the operator.

VII. Brunel gives another formula for a brassing solution.

Carbonate of potassa	10 lbs.
Cyanide of potassium	1½ „
Sulphate of zinc	1½ „
Chloride of copper	10 ozs.
Water	12½ gals.

The best way of making up the above solution, is to dissolve all the ingredients in separate vessels; then to add to the sulphate of zinc and chloride of copper a portion of the solution of carbonate of potassa. Now add sufficient liquid ammonia to dissolve the respective precipitates thus formed, when the solution of cyanide and remainder of the carbonate of potassa may be poured in, and the rest of the water added to make 12½ gallons. This solution must be worked with a large brass anode and a brisk battery of two or more cells. It is advisable to let the solution remain for some hours before using it, when it should be separated from any sediment which may remain at the bottom of the vessel in which it is made.

The above solution will require to be replenished, from time to time, with a little cyanide of potassium, and, occasionally, a little liquid ammonia may be added, in order to keep in solution any salt of zinc which may show itself upon the anode, and which salt is not soluble in cyanide. After working the solution for some weeks it will be advisable to add a little arsenious acid, in order that the deposit may be rendered brighter. I have also found that a little chloride of tin, previously digested with caustic potassa, improves the character of the deposit of brass, inasmuch as it tends to toughen the deposit.

Iron, lead, zinc, tin, and alloys of lead, &c., will not all receive an equally good deposit of brass in the same bath, therefore it will be necessary to employ a different solution for each metal or alloy.

Cast iron requires a solution containing a greater percentage of metal than zinc or its alloys; whilst zinc will receive a good deposit when but little metal is in solution. Lead also requires to be coated in a solution richer in metals.

It is injurious to a brassing bath to immerse in it an article of iron and one of zinc or any other metal, at the same time, for one of them will receive the deposit in preference to the other, and, in striving to make them both receive the deposit at the same time, the solution very often becomes injured by the operator. It is, therefore, better to employ a solution for each metal; thus, one for cast iron, another for wrought iron, and a third for zinc, &c. By observing this rule the solutions are less liable to get disordered.

Again, iron and zinc require different degrees of battery power to effect a good deposit upon them. A battery which would coat zinc thoroughly well in all respects might not deposit at all upon a surface of cast iron; therefore these metals should not be in the same bath, at the *same time* at all events.

London, November, 10, 1855.

(*To be continued.*)

To the Editor of "THE CHEMIST."

COD-LIVER OIL with QUININE.

SIR,—I had thought that most chemists were aware that pure quinine (like other resins) was soluble in oils and spirits. Cod-liver oil with quinine, which seems at the present time to attract so much attention, and have so many claimants for its discovery, is easily prepared as follows:—

First, prepare the quinine by dissolving two drams of the disulphate in half a pint of water acidulated with two drams of dilute sulphuric acid; then precipitate by the addition of one and a half drams of liq. ammonia; project on a filter, and wash the precipitate with four or five ounces more water. When the precipitate has been well drained, scrape off the quinine, introduce it into an evaporating basin, and set it in a steam bath; the heat will cause the quinine to *melt* and separate from the interstitial water, which should be poured off, and the quinine collected on bibulous paper to dry, when it can be finely powdered and preserved for use.

To prepare the Oil.—Take sixteen grains of the precipitate, and dissolve in eight ounces of cod oil by means of a gentle heat; the oil will become slightly colored. This, however, is best obviated by dissolving the quinine in a mixture of one dram each of ether and alcohol, and mixing the solution with the oil, and then evaporating the spirit by means of a steam bath, agitating it occasionally with a glass rod; if the oil requires filtration, it should be passed through a piece of lint loosely inserted in the neck of a funnel.

Every ounce of the oil will thus contain two grains of quinine.

I am, Sir, yours truly,

JOHN HORSLEY.

THE LABORATORY, Cheltenham, Nov. 10, 1855.

CHEMICAL TABLES. COMPILED BY THORNTON J. HERAPATH.

No. IV.—Table showing the Behavior of Substances with Reagents, and for Testing by the Blowpipe:—Proximate Organic Analysis.

Distinctive Reactions are printed in *italics*. Precipitants used in quantitative analysis are distinguished by an *.

C'.—ORGANIC SUBSTANCES :—ACIDS.

CLASS II.—NON-VOLATILE ACIDS.

Sub-Class II.—Acids, not Fatty.

*** Acids which neither strike a black color with salts of iron, nor give a precipitate with salts of potash.

(Continued from p. 76.)

Name of Acid, and Composition.	Atomic Weight	Action of Special Tests, &c.
Lactic acid, C ⁶ , H ⁸ , O ⁵ , in combination.	81	Uncrystal. Monobasic. Lactate of lime is readily sol. in boiling water, and crystal. on cooling in short prisms; <i>it is more sol. in alcohol than in water. Lactate of zinc cryst. in 4-sided prisms, with obliquely truncated summits.</i>
Hippuric acid, C ⁸ , H ⁶ , N, O ⁵ , in combination.	170	Readily cryst. in short radiated needles or granular powder, or in 4-sided prisms with dièdral summits. When boiled with dil. hydrochl. or nitric acid, <i>the solu. on cooling deposits benzoic acid. When peroxide of lead is boiled with a solution of hippuric acid, the mixture concretes into a crystal. mass of benzamide.</i>

D'.—ORGANIC SUBSTANCES :—BASES, &c.

CLASS I.—SUBSTANCES SOLUBLE IN BOILING ETHER.

Sub-Class I.—Volatile Substances.

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
Certain vegeto-alkalies or alkaloids	Coneine—from hemlock (C ¹⁷ , H ¹⁷ , N=133); Hyoscyamine—from henbane (comp. uncertain); Nicotine—from tobacco (C ¹⁰ , H ⁷ , N=81); Secalinaline—from the ergot, &c. (C ⁶ , H ⁹ , N=59); Sparteine—from the broom, &c. C ¹⁵ , H ¹³ , N=117). <i>These alkaloids exert an alkaline reaction on test-papers, and readily combine with acids to form fixed salts. Distinguished by their odor, &c. Vide THE CHEMIST. N.S., vol. iii., p. 52.</i>

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
Essential Oils . . .	<i>Do not form salts with acids; and are neutral to test-papers.</i> Distinguished by their odor, refractive power, action on polarised light, composition, and the products of their decomp. <i>Vide</i> various works on Organic Chemistry. <i>Oils containing sulphur when boiled with alkal. solu. in a silver vessel, stain the metal of a dark col. in consequence of the formation of sulph. of silv.</i>
Camphor . . .	Veg.—comp., $C^{10}, H^8, O=76$; C, 78.95%; H, 10.52%; O, 10.52%. Is sublimable, crys. in small prismatic crys. Possesses a peculiarly grateful odor. <i>Is readily sol. in alcohol, and is pptd. therefrom by water, in plumose crys. Is not sol. in dil. acids; but by the action of heat and strong nitric acid, is converted into camphoric acid.</i>
Borneo camphor . . .	Veg.—only in <i>Dryobalanops</i>. Comp., $C^{10}, H^8, O=77$. Very similar to ordinary camphor, but possesses a peculiar and <i>slightly alliaceous</i> odor.
Coumarine . . .	Veg.—only in Tonka bean, flowers of Melilot, <i>Asperula</i>, and sweet vernal grass. Comp., $C^{18}, H^7, O^4=147$; C, 73.47%; H, 4.762%; O, 21.768%.
Caryophylline . . .	Is very similar to the camphors, <i>but is soluble in boiling water, and deposited on cooling in long silky prisms. Strong nitric acid, by long boiling, converts into carbazotic acid. Readily sol. in dil. acids.</i> Veg.—only met with in cloves (?). Comp., C^{10}, H^8, O, like camphor.
Cantharidine . . .	Is almost inodorous: and does not sublime so readily as camphor. Animal.—Only in cantharides, <i>Myiobris</i>, and <i>Meloe</i>. <i>Is vol. only at temp. much above 212°.</i> Is sol. in alcohol, and crys. in colorless plates, like spermaceti. Is sol. also in chloroform, <i>yielding a vesicatory solu.</i>
<i>Sub-Class II.—Non-Volatile Substances.</i>	
Certain vegeto-alkalies or alkaloids, and pseudo-alkaloids.	Aconitine—from various species of <i>Aconitum</i> (comp. uncertain); atropine—from the deadly nightshade and thornapple ($C^{24}, H^{23}, NO^6=289$); aricine—from arica bark ($C^{20}, H^{12}, NO^3=170$); codeine—from opium ($C^{28}, H^{31}, NO^6=299$); papaverine—opium ($C^{40}, H^{31}, NO^6=339$); meconine—opium ($C^{10}, H^4, O^4=97$); narcotine—opium $C^{40}, H^{20}, NO^{12}=370$); thebaine—opium (comp. uncertain); colchicine—from <i>colchicum</i>; curarine—from worari poison (comp. uncertain); menispermine—from <i>Cocculus Indicus</i> ($C^{18}, H^{12}, NO^2=150$); picrotoxia—from the same (comp. uncertain); piperine—from pepper ($C^{34}, H^{19}, NO^4=285$); quinine—from Cinchona bark ($C^{20}, H^{12}, NO^2=162$); santanine—from <i>artemisia contra</i> comp. uncertain); smilacine—from sarsaparilla ($C^5, H^{12}, O^4=83$).

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent, and Action of Special Tests.
	[Cinchonine, delphine, morphine, <i>phloridzine</i>, and veratrine are also sp. sol. in æther.] <i>Most of the above substances have an alkaline reaction, possess a very bitter taste, are very sol. in dilute acids, combine with acids to form cryst. salts, and are ppt. yellow by bichloride of platinum.</i> Distinctive tests:—Atropine and aconitine cause dilatation of the pupil; delphine, morphine, and narcotine, red to nitric acid; papaverine, blue to sulphuric acid; santonine, carmine red to caustic alkal.; quinine, Herapath's test. <i>Vide THE CHEMIST</i>, N.S., present vol., pp. 52-55.
Natural fats	Veg. and animal. Oleine—C^{47}, H^{91}, $O^6=863$; phocentine—C^{13}, H^9, $O^4=119$; margarine—compos. somewhat uncertain; stearine C^{71}, H^{68}, $O^6=542$, &c. Are insol. in water, and dil. acids. <i>All compounds of fatty acids and oxide of lypyle, C^3, H^2O. When heated with alkal. solu. they yield soaps, which may be 'parted' from the solu. by the addition of common salt; when boiled with oxide of lead and water they yield 'plasters'; while in both cases glycerine is set free. These soaps, when acted upon by dil. acids, are decomp., and the fatty acids are liberated (vide C—Fatty acids). When subjected to destructive distillation, the fats yield a distillate containing acroleine, which may be distinguished by its intolerable odor.</i>
Fixed, or fatty oils	Veg. and animal.—Closely resemble the preceding in the chemical and physical properties. <i>Vide</i> a paper by Professor Calvert in <i>THE CHEMIST</i>, N.S., vol. i., p. 257, <i>et seq.</i>; Table of Sp. Gr., vol. i., p. 331; also Brande's Manual of Chemistry, vol. ii., p. 1248, <i>et seq.</i>
Spermaceti (cetine)	Animal.—Found only in the fat of the head of sperm-whale. C^{308}, H^{508}, $O^{16}=1584$. <i>Comp.=C</i>, 78.78%; <i>H</i>, 13.13%; <i>O</i>, 8.09%.
Cholesterine	Is insol. in dil. acids, and difficultly saponified by alkal. solu., with liberation of æthal, and formation of cetylate of potash (spermaceti soap). It crys. in beautiful nacreous lamellæ, or little pearly scales, after solu. in boiling alcohol. Animal.—In brain, yolk of egg, blood, bile, and biliary calculi. Is very sol. in boiling alcohol, and crys. readily on cooling, like cetine, in beautiful silvery scales or plates, some with retreating angles. [<i>Vide</i> Otto Funke's plates, Cavendish Soc., pl. vi., figs. 1 and 2.] <i>Is not saponified. Under the microscope the crys., when acted upon by dil. sulphuric acid (3 pts. acid+1 pt. water) become tinged of a violet, red, or bluish color at the edges; and with concent. sulphuric acid and iodine, a blue tint resembling that of cellulose.</i> (Moleschott. Meckel.)

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
Wax	Veg. and animal.—Composition different in dif. varieties. <i>Bee's wax</i> and <i>ordinary vegetable wax</i> consists of two substances, <i>cerotic acid</i> (<i>cerine</i>), which is very sol. in boiling alcohol and <i>palmitate of melissyle</i> (<i>myricine</i>) which is almost insol. in alcohol. By boiling nitric acid it is converted into <i>succinic acid</i>. Wax is unsaponifiable by <i>alkal. solu.</i>
Certain resins . . .	Veg.—Soluble in <i>alkal. solu.</i>, but the resulting <i>resinate</i> is not separable by common salt.
Caoutchouc	Veg.—Insol. in <i>alkal. solu.</i> alcohol, and acids, but readily sol. in <i>bisulphide of carbon</i>, <i>turpentine</i>, and <i>naphtha</i>. Is highly elastic. When subjected to destructive distillation yields a very light, inflam. <i>hydrocarbon-caoutchine</i>.
Certain coloring matters.	Veg.—Indigogene, alizarine, purpurine, alkanet green, anchusine, brasiline, curcumine, fustin, lecanoric acid, luteoline, orelline, quercetreine, rocellic acid, santaleine, usnine, &c. <i>[Vide various works on chemistry.]</i> Indigogene is converted into indigo-blue (<i>indigotine</i>) by exposure to air. Alazarine differs from purpurine in being insol. in a cold solu. of alum.
CLASS II.—SUBSTANCES INSOLUBLE IN ÆTHER, BUT SOLUBLE IN ALCOHOL. Certain vegeto-alkaloids, <i>pseudo-alkaloids</i>, and <i>glucosides</i>.	
	Brucine—from <i>nux-vomica</i>, <i>St. Ignatius bean</i>, and false <i>Augustura bark</i> ($C^{44}, H^{35}, N^2, O^7=378$); strychnine accompanies the preceding ($C^{44}, H^{35}, N^2, O^8=381$); cinchonine—<i>cinchona bark</i> ($C^{30}, H^{12}, NO=154$); delphine—from <i>stavesacre</i> (comp. uncertain); digitaline—from <i>foxglove</i> (comp. uncertain); elaterine—from <i>elaterium</i> (comp. uncertain); emetine—from <i>ipecacuanha</i> ($C^{37}, H^{27}, NO^{10}=343$); ergotine—from <i>ergot</i> (comp. uncertain); saponine—from root of <i>saponaria</i> (comp. uncertain); <i>salicine</i>—from bark of willow ($C^{26}, H^{18}, O^{11}=286$); <i>phloridzine</i>—from bark of roots of the poplar, &c.; morphine—from opium and <i>lactucarium</i> (;) $C^{34}, H^{19}, NO^6=285$; Narceia—accompanies the preceding ($C^{46}, H^{29}, NO^{18}=463$);
	<i>Most of the above substances possess a very bitter taste, have an alkaline reaction, are sol. in dilute acids, and combine with acids to form crys. salts.</i>
	Distinctive tests:—Digitaline causes dilatation of the pupil of the eye; with concent. sulphuric acid, purple; brucine, morphine, delphine, veratrine, and narcotine, red to nitric acid; morphine, bluish-black to perchl. of iron; and fine blue to a mixture of starch and iodic acid; strychnine, purple to Otto's test; narcotine, crimson to nitrate of potash with sulphuric acid; veratrine, deep claret-red with bichromate of potash and vitriol. <i>Vide THE CHEMIST, N.S., vol. iii., p. 53, et seq.</i>

TRANSLATIONS AND ABSTRACTS.

ORGANIC CHEMISTRY.

On the FORMATION of CAPRYLIC ALDEHYDE.

By M. BOUIS.

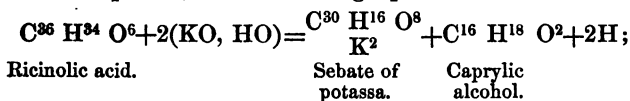
IN a Memoir which I presented to the Academy at its sitting of May 22, 1854, (See THE CHEMIST, New Series, Vol. I, 1853-4, p. 597), I observed that, in order to obtain caprylic alcohol in the pure state, it was necessary to distil it several times over solid potassa in order to destroy a foreign matter which becomes brown and viscid. This foreign substance, which is formed in caprylic alcohol in only very minute proportions, is in great part caprylic aldehyde, and I shall now point out the circumstances in which it may be produced.

I saponified castor oil with soda and removed the excess of alkali with chloride of sodium; the soap, after being well pressed, was redissolved in water and again precipitated with common salt, so as to remove the last traces of free soda. This soap, completely dried, submitted by small portions at a time to distillation, furnished a limpid, colorless liquid, boiling towards 172° C. (341° 6' F.), reducing ammonio-nitrate of silver into a brilliant layer, and combining with the alkaline bisulphates. During the reaction, *no gas is disengaged*, if the operation is properly conducted.

The salt of soda left in the retort furnishes acids in which the presence of sebacic acid may be proved.

The ricinolate of soda, obtained by means of pure ricinolic acid, gave me identical results, and I have likewise employed with success the baryta soap, prepared by decomposing the soda soap of castor oil with chloride of barium.

These facts established will now give us the key to that which is produced in the preparation of caprylic alcohol. In heating castor oil with an excess of potassa or soda, it is easy to comprehend, from the foregoing, that we may obtain at will caprylic alcohol or caprylic aldehyde. If, indeed, the temperature is raised so suddenly as to fuse the alkali, there is a formation of nearly pure alcohol, accompanied by a disengagement of hydrogen; and, in this case, the production of sebacic acid is proved, as the following equation indicates:—



but if the operation is conducted very slowly, and if the temperature does not exceed 225 or 230° C. (437 to 446° F.), the product of the distillation will be composed, notwithstanding the great excess of alkali, of a mixture in variable proportions of alcohol and aldehyde. The soap will contain so much the less sebacic acid as there is more aldehyde and consequently less alcohol.

The distilled liquid, treated with bisulphate of soda or ammonia, be-

comes a crystalline or gelatinous mass, which is strongly pressed in a fine cloth in order to remove the caprylic alcohol and the excess of the salt employed. The expressed matter is decomposed with hot water, and recombined with the bisulphate until the product is pure.

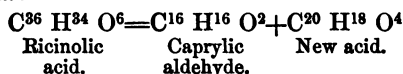
Caprylic aldehyde is a very refringent colorless liquid, whose density is equal to 0.818 at 19° C. (66° 2' F.); it boils at 171° C. (339° 8' F.) under the ordinary pressure. Its odor is very powerful, and resembles that of the banana; its taste is caustic; it is insoluble in water, soluble in alcohol, ether and the fat oils; it burns with a very beautiful, bright and smokeless flame.

Caprylic aldehyde reduces ammonio-nitrate of silver, giving a beautiful metallic mirror: it does not appear to oxidise cold under the influence of the air or even of oxygen. I have kept caprylic aldehyde for several months in oxygen, in presence of spongy platinum, without the least alteration. When hot, it rapidly acidifies, and the reaction is so energetic in oxygen, that an explosion may occur.

Nitric acid exerts a very violent action on caprylic aldehyde; potassa turns it brown, and transforms it into a brown, viscid, fixed matter, which I have already mentioned in speaking of the purifications of caprylic alcohol.

Caprylic aldehyde combines with the alkaline bisulphates without the least elevation of temperature being observed; these combinations are insoluble in water charged with a bisulphate; warm water destroys them and separates the aldehyde in the pure state. Prepared by this means caprylic aldehyde boiling at 171° C. (339° 8' F.), furnished by analysis numbers exactly agreeing with the formula $C^{16} H^{16} O^2$.

In the preparation of caprylic aldehyde by the dry distillation of the ricinolates, we observe no disengagement of gas nor formation of sebacic acid. The acid which remains in combination with the soda, is very viscid and finally acquires a pasty consistence. I think I may assign to it the composition $C^{20} H^{18} O^4$, which, moreover, is logically deduced from the formula:—



The above brief observations clearly explain the results announced by Will, Railton, and Limpricht, who obtained mixtures of alcohol and aldehyde, and account for the contradictory statements published on this question.

I will conclude this Note by announcing that I have been enabled to turn to account, with loss, the excess of alkali necessary for the preparation of caprylic alcohol and sebacic acid. This process, which is much more economical, is based on the property which sebate of potassa or soda possesses of separating, like common salt, alkaline soaps. This character of sebacic acid, added to its solubility, and that of its salts of lime and baryta, makes it differ from the class of fatty acids, which in several respects it resembles.

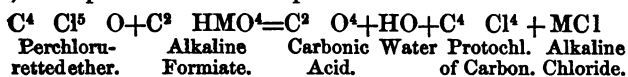
Comptes Rendus, No. 16, Oct. 15, 1855.

NOTE on the PROPERTIES of supporting COMBUSTION OF PERCHLORURETTED ETHER.

By M. F. MALAGUTI.

WHEN we distil a mixture made with equivalent quantities of an alkaline formiate and perchloruretted ether, we obtain proto-chloride of carbon ($C^4 Cl^4$), carbonic acid, water and alkaline chloride.

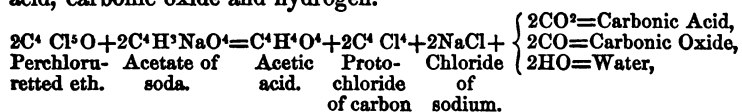
In this reaction, the alkaline metal is evidently burned by a portion of the chlorine of the ether, and the oxygen of this same ether is added to that of the salt, in order to burn completely the other elements; the perchloruretted ether, having lost a molecule of chlorine and all its oxygen, must pass to the state of proto-chloride of carbon :



The combustible faculty of perchloruretted ether is thus manifest, since a portion of the elements of this body takes part in the complete combustion of the elements of the salt.

I asked myself whether this elegant reaction was not an isolated fact caused by this circumstance, that all the combustible elements of the formiate are formed in presence of a sufficient quantity of principles supporting combustion to be burned. Experiment alone could answer this, although it was certain that a complete combustion would be impossible if we operated with a more complex salt than a formiate; nevertheless, it would still remain to be ascertained whether perchloruretted ether plays, in other cases, the same part of a supporter of combustion, whatever may be the nature of the products to which it may give rise.

I made a new experiment with fused acetate of soda, and I obtained protochloride of carbon, crystallisable acetic acid, chloride of sodium without a trace of carbonate, and a gaseous mixture formed of carbonic acid, carbonic oxide and hydrogen.



There are two remarkable facts in this reaction, only one of which could be foreseen. Indeed, in attributing, also, in this case, the supporting faculty to the perchloruretted ether, we should expect to obtain products of incomplete combustion, such as carbonic oxide: but nothing warranted us in anticipating the formation of crystallisable acetic acid.

The appearance of this acid led me to suppose, and experiment confirmed the supposition, that perchloruretted ether should act only on salts with volatile acids, and that all the alkaline organic salts which are formed in this case should act like the acetates. Indeed, if I failed with the citrates, the tartrates &c., &c., I perfectly succeeded with the butyrates, valerianates, benzoates, succinates, pyrocitrates, phtalates,

camphorates, and salicylates. All these salts distilled with perchloruretted ether gave protochloride of carbon, normal acid, alkaline chloride without carbonate, and a gaseous mixture formed of carbonic acid and combustible gases.

It must be remarked, however, that the salts with a bi-atomic acid generally give anhydride and water, instead of normal acid. Example: in distilling an alkaline camphorate with perchloruretted ether, we obtain the ordinary products, but instead of normal camphoric acid, water and beautiful needles of anhydrous camphoric acid are formed: as the anhydride, plus water, represents the normal acid, it follows that the reaction of bi-atomic salts is the same as that of mono-atomic salts.

I have met with only one exception in my experiments. The mode of decomposition of the alkaline salicylates is generally the same as that of the other salts, with the exception that salicylic acid is not formed, but various substances soluble in the alkalis, and which I have not studied.

Once certain as to the conditions in which the supporting faculty of perchloruretted ether is manifested, I asked myself if it was necessary that the salts should be of an alkaline base. I operated with acetate of baryta, with acetate of lead, with butyrate of lime, and the experiment succeeded completely. It was different with acetate of copper, the easy decomposition of which under the influence of heat did not allow the perchloruretted ether to exert its action. Indeed, each body gave the products proper to its igneous decomposition.

I think I may therefore state that perchloruretted ether acts as a supporter of combustion to organic salts of a volatile acid, as often as the stability of the salt renders the action possible.

The following is the general enunciation of the fact. *When perchloruretted ether acts on an organic salt with a volatile acid, the two bodies are decomposed, the perchloruretted ether passes to the state of protochloride of carbon, the metal of the salt passes to the state of chloride, whilst the other elements are grouped in such a manner as to give rise to the normal acid, carbonic acid and combustible gases.* The facts which I have just stated increase the importance of perchloruretted ether, of that body which, discovered by M. Regnault and afterwards studied by myself, has not, so far as I know, attracted the attention of chemists. However, few substances can be so serviceable in laboratories; when we have perchloruretted ether, we have the raw material for obtaining with the greatest facility several highly interesting products, whose preparation by the ordinary process is tedious, difficult and expensive.

Thus, with perchloruretted ether, we may obtain immediately,

Protochloride of carbon	.	.	.	.	$C^4 Cl^4$,
Sesquichloride of carbon	.	.	.	.	$C^4 Cl^6$,
Chloroxethose	.	.	.	.	$C^4 Cl^3 O$,
Chloruretted aldehyde	.	.	.	.	$C^4 Cl^4 O^2$.

By exposing chloroxethose with bromine to the sun, we obtain perchloro-bromuretted ether= $C^4 Cl^3 OBr^2$.

By passing into water the product of the sudden distillation of perchloruretted ether, we obtain a solution of very pure chloracetic acid= $C^4 Cl^3 HO^4$.

If then alcohol is substituted for water, we have chloracetic ether= $C^4 H^5 O$, $C^4 Cl^3 H^2 NO^2$. When ammonia is substituted for alcohol, we have chloracetamide= $C^4 Cl^3 H^2 NO^2$.

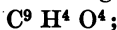
This is sufficient, I think, to demonstrate the importance of M. Regnault's perchloruretted ether.

Comptes Rendus, No. 17, Oct., 22, 1855.

On INSOLINIC ACID, a product of the OXIDATION of CUMINIC ACID.

By M. A. W. HOFMANN.

IN trying to purify cuminic acid by boiling with chromic acid, I remarked that this acid experienced, on the part of this reagent, a progressive alteration. By a treatment of twenty-four hours, cuminic acid is completely converted into an acid insoluble in alcohol and ether, and almost insoluble in water, to which I have, for this reason, given the name of insolinic acid; purified by the ordinary processes, this body gave by analysis the following relations:—



but the analysis of the salts demonstrates that this formula should be doubled, insolinic acid being a bibasic acid.

I have examined a series of salts, of which the following is the composition:—

Free insolinic acid	. . .	$C^{18} H^8 O^8$
Salt of silver	. . .	$C^{18} (H^6 Ag^2) O^8$
Salt of copper	. . .	$C^{18} (H^6 Cu^2) O^8 + HO, Cu O$
Salt of barium	. . .	$C^{18} (H^6 Ba^2) O^8$
Salt of calcium (at 100° C. 212° F.)		$C^{18} (H^6 Ca^2) O^8 + 6HO$
" " (at 130° C. 266° F.)		$C^{18} (H^6 Ca^2) O^8$
Neutral salt of potassium	. . .	$C^{18} (H^6 K^2) O^8$
Acid " "	. . .	$C^{18} (H^7 K) O^8$
Salt of potassium and sodium	. . .	$C^{18} (H^6 K Na) O^8$

If we consider this acid as an isolated body it presents no very great interest to the chemist; it acquires, on the contrary, a certain degree of importance, when regarded from the point of view of the relations it presents to other compounds. Some years ago M. Gerhardt noticed the fact of the existence of a series of bibasic acids containing eight atoms of oxygen, which present among themselves relations perfectly analogous to those which are observed between the bodies which compose the very curious series of monobasic acids with four atoms of oxygen, whose first term is formic acid, and which is generally designated under the name of the series of fat acids. These series of acids are connected by the closest ties, and very conclusive experiments have demonstrated that they may easily pass from one to another; such is the case of the transformation of butyric acid into succinic acid, effected by M. Dessaignes under the influence of oxidising agents.

The following table exhibits what we have just said :—

Formic acid	. $C^2 H^2 O^4$	Oxalic acid	. $C^4 H^2 O^8$
Acetic acid	. $C^4 H^4 O^4$	?	. $C^6 H^4 O^8$
Propionic acid	. $C^6 H^6 O^4$	Succinic acid	. $C^8 H^6 O^8$
Butyric acid	. $C^8 H^8 O^4$	Pyrotartaric acid	. $C^{10} H^8 O^8$
Valerianic acid	. $C^{10} H^{10} O^4$	Adipic acid	. $C^{12} H^{10} O^8$
Capoic acid	. $C^{12} H^{12} O^4$	Pimelic acid	. $C^{14} H^{12} O^8$
CEnanthylic acid	. $C^{14} H^{14} O^4$	Suberic acid	. $C^{16} H^{14} O^8$
Caprylic acid	. $C^{16} H^{16} O^4$	?	. $C^{18} H^{16} O^8$
Pelargonic acid	. $C^{18} H^{18} O^4$	Sebacic acid	. $C^{20} H^{18} O^8$
Rutic acid	. $C^{20} H^{20} O^4$		

The existence and mode of formation of insolinic acid demonstrate the existence of a series of bibasic acids with eight atoms of oxygen, which present relatively to the series of monobasic acids with four atoms of oxygen, of which benzoic acid is the first term, the same relation as that which is observed between succinic acid and butyric acid. Hitherto, we were acquainted with only a few terms of this series of bibasic acids, but the list of aromatic acids itself is at present very incomplete.

I have collected, in the following table, the numbers belonging to these two groups of bodies :—

Benzoic acid	. $C^{14} H^6 O^4$	?	. $C^{14} H^4 O^8$
Toluic acid	. $C^{16} H^8 O^4$	Phthalic acid	. $C^{16} H^6 O^8$
?	. $C^{18} H^{10} O^4$	Terephthalic acid	. $C^{18} H^8 O^8$
Cuminic acid	. $C^{20} H^{12} O^4$	Insolinic acid	. $C^{20} H^{10} O^8$
		?	

If we take the carbon as the starting point for the comparison, it is evident that the insolinic acid corresponds to the acid placed between toluic acid and cuminic acid, which is still unknown. Besides insolinic acid, there are at present only the phthalic acid of M. Laurent, and the terephthalic acid of M. Caillot, which belong to the group of bibasic acids, the two isomers corresponding to toluic acid. Benzoic and cuminic acids are not yet represented in the series of aromatic bibasic acids.

In order to prepare the acid corresponding to benzoic acid, I treated with chromic acid the cymene which toluic acid furnishes when it is oxidised by means of dilute nitric acid. But cymene furnishes only insolinic acid.

During my stay in Paris, M. Persoz directed my attention to some experiments which he had made, ten years ago, on the oxidation of cummin oil. It seems that the existence of insolinic acid was foreseen by this chemist, whose observations are not, however, accompanied by analytical data. I here give only a summary indication of the new results which the action of chromic acid on the acids of the benzoic group furnished me, reserving the details for an extended memoir.

Comptes Rendus, No. 18, October 29, 1855.

NOTE on SEVERAL PHENOMENA of OXYGENATION and REDUCTION.

By M. F. KUHLMANN.

IN my preceding Note (see page 86) I noticed the property which the resinifiable essences possess of absorbing oxygen from the air, and of being capable, in the first stage of this absorption, of becoming energetic agents of oxidation.

This oxidising property, the energy of which is augmented by heat, belongs likewise to crude turpentine, and it also exists in varnishes.

When, by any action whatever, the oxygen absorbed has been abstracted from the essence; when, for example, this oxygen has served for decoloring a sulphuric solution of indigo; the essence absorbs oxygen *de novo*, and becomes capable of acting gradually on a large quantity of coloring matter, as takes place in the action of the essence on sulphurous acid. We must say, however, that in this succession of reactions, the essence undergoes modifications which demand further studies.

By slowly passing a current of oxygen without heat through a sulphuric solution of indigo, constantly agitated with newly distilled essence of turpentine, the indigo is decolorized in a very short time. In contact with the air and without the direct action of the solar rays, this result would take place after several days.

Tincture of litmus decolorized by a solution of hyposulphite of zinc, in contact with the aerated essence, takes a red color, and when we saturate the free acid, the blue color is reproduced with its original intensity.

Essence of citron and other resinifiable or acidifiable essences, act like essence of turpentine; essence of bitter almonds produces the phenomena of oxydation and decoloration in the highest degree.

I have also experimented with nut oil, which is, as is known, one of the fat oils which absorbs most oxygen. The same reaction, it appears to me, ought to be produced with more or less energy by all the fat oils and the fats; the confirmation of this fact would give an explanation, as simple as easy, of what occurs in the bleaching of palm oil, wax, &c., under the influence of the oxygenising bodies. The fatty matter serving as an excipient would convey the oxygen to the coloring matter before this oxygen was fixed in a stable manner.

There are carburets which appear to refuse the absorption of oxygen; benzine, for example, does not give rise to the above mentioned phenomena, unless, perhaps, in consequence of very long continued exposure to the air. On the other hand, ether and the alcohols possess in variable degrees the property of absorbing oxygen and of reacting afterwards on colors and on oxidisable bodies before being acidified.

Ether, especially, quickly decolors the solution of indigo, and precipitates basic sulphate of sesquioxide of iron from a solution of sulphate of protoxide. In this last reaction, there was however no elevation of temperature as with the aerated essence.

In the reduction of oxygenised bodies, things very often occur the same as we have just indicated as regards the oxygenation, only the

hydrogen, which most frequently intervenes as a reducing principle, resists every solution much better when it is isolated, but its effects are manifested energetically as soon as it is combined with some other combustible body. Thus marsh gas, and especially sulphuretted hydrogen, act on vegetable colors, decoloring them by disoxygenation, and on metallic salts by reducing them. When hydrogen acts on certain metallic salts, we may admit that its action is exerted by favor of this body dissolved in the liquid which should give rise to it. I have proved, however, that the liquid in which hydrogen is developed by the action of dilute sulphuric acid or zinc, does not reduce the chloride of silver; it is necessary for this that there should be a communication, either direct, or by means of a conducting body, between the zinc and the chloride in question.

But when the metallic salt is in solution, the reduction proceeds rapidly, and the reduced body is often carried away in combination with the hydrogen, as occurs with sulphuretted and arsenieuretted hydrogen, &c.

Must we not attribute to sulphur an action analogous to that of oxygen or hydrogen dissolved and not yet fixed in a stable manner, in the following circumstances? When we put zinc in contact with a solution of sulphurous acid in water, and when, according to the generally received opinion, sulphite and hyposulphite of zinc are formed, the liquid assumes a yellow color, which gradually disappears by the formation of insoluble sulphuret of zinc. Now, it appears that so long as the yellow color remains, the decoloring power of the liquid is infinitely more powerful than after the deposition of the sulphur. The sulphur is here evidently in a state intermediate between solution and a stable combination, a state analogous to that of the oxygen in the essence or ether.

When the gases act on the animal economy in the respiration it is also their solubility which, in my opinion, exerts a great influence. Thus we account for the irritant action of protoxide of nitrogen, which acts in part like free oxygen.

The deleterious action of carbonic oxide, and especially of sulphuretted hydrogen, is accounted for by the solubility of these gases; it results, independently of every other poisonous property, from the subtraction which they produce to their own profit, of the oxygen absorbed by the blood. The more soluble these gases are, the more energetic is their action; for the lungs, at each inhalation, deprive the air of the deleterious gas, and thus also determine its accumulation.

When the hyposulphites remove the oxygen from the essence and the aerated carburets in general, they produce an effect analogous to the action of hydrosulphuric acid on the blood.

Comptes Rendus, No. 15, Oct. 8, 1855.

ANALYTICAL CHEMISTRY.

*On CHLOROMETRY, and on the SPONTANEOUS TRANSFORMATION of
HYPOCHLORITES into CHLORITES.*

By MM. M. J. FORDOS and A. GELIS.

IN 1847 we proposed to substitute in commercial chlorometric tests, for the normal arsenious liquor, a normal liquor of hyposulphite of soda, founding our proposition on the danger arising from leaving so poisonous a substance as arsenic open in places of business. The same substitution has subsequently been proposed in Germany, but with alterations in the method of operating which were not improvements, based on the fact that arsenious acid in solution becomes in time transformed into arsenic acid. An accidental observation leads us now to return to this subject.

While analysing mixtures of various sulphur acids by our method, we were led to make the observation of which we speak. This method, which is based on the action which the hypochlorites in solution exercise on compounds, gives very exact results, on condition that the test liquors are carefully estimated when about to be used. This estimation may be made by any known chlorometric process, but we give the preference to the solution of hyposulphite of soda, 0.1 of this salt absorbing 0.114 of chlorine in its transformation into sulphate of soda. However, as this method has hitherto only been used by ourselves, we make our tests comparatively with two different liquors.

It is this system, of which we make a habit, that led us to observe the curious fact, which is the object of this note. Two liquors* giving similar results when used to estimate the solutions of recently prepared hypochlorites, but which had not the same value when used with old solutions.

We operated sometimes with hypochlorite of lime, sometimes with hypochlorite of soda, and our liquors, which lasted sometimes for months without being renewed, were placed on a shelf in the laboratory, exposed to the light, but to which the sun seldom reached. When we had one or more estimations to make, we ascertained by a double test the changes which time had made in the value of the liquor since the last experiment; each time the hypochlorite had lost its strength, but the difference found in the arsenious liquor and the solution of hyposulphite of soda had not been equivalent. Thus, to cite an extreme case, a liquor which produced no reaction in Gay Lussac's process, still acted sensibly on the hyposulphite of soda.

We then examined this hypochlorite by means of the process of Descroizilles, that is with tincture of indigo, we found that it still destroyed a considerable quantity of this reagent, and that this process gave indications comparable to those given by the hyposulphite.

This fact was too important in connection with chlorometrical tests

* One was the arsenious liquor of Gay Lussac, prepared by ourselves; the other was equivalent, and contained 2.77 grs. of hyposulphite per litre.

not to attract all our attention, and we soon ascertained, by the chemical examination of the liquors, that these differences should be attributed to the partial transformation of the hypochlorites into chlorites under the influence of diffused light. The liquor which had no influence on the arsenious solution, and which, nevertheless, decomposed hyposulphite of soda and indigo, took, by the addition of a diluted acid, and particularly of hydrochloric acid, a decided green tint, and the characteristic odor of chlorous acid discovered by M. Millon — an acid which, as is well known, does not transform arsenious into arsenic acid. This liquor, compared with a solution of chlorous acid, purposely prepared, showed all the same characters.

This must consequently be added to the numerous list of variations which light, in its various states, may cause in chemical reactions, and principally in the compounds of chlorine. This fact would consequently deserve to attract attention from chemists, even if no such practical industrial interest were attached to it as we have mentioned.

The errors which it may occasion in the determination of the richness of decoloring compounds appears to us of sufficient importance to cause the rejection of the arsenious liquor from chlorometrical tests; for the merchant and dyer seek in these experiments to ascertain, not the exact amount of hypochlorous acid existing in the compound tested, but rather the quantity of colored matter which a known weight of this compound is able to destroy. The end was obtained by the method of Descroizilles, and we think it is quite unnecessary to go farther in search of the cause of certain disputes.

We therefore again urge manufacturers to abandon the arsenious liquor, and to replace it by a normal liquor of hyposulphite of soda.

To prepare this normal liquor 277 grs. of this salt are to be dissolved without heat in sufficient water to form a litre of the liquor. This liquor, which is comparable to the arsenious liquor of Gay Lussac, will destroy exactly its own volume of chlorine.

Hyposulphite of soda is a well crystallised salt, very soluble in water, of a constant composition: air takes no effect on it; it is without action on the human economy, and is in every respect preferable to arsenious acid, whose terribly injurious characteristics are so well known.

The substitution which we propose makes no great change in the *modus operandi*: all Gay Lussac's directions are to be followed. The following are the only modifications which the nature of the reagent which we recommend requires in the process.

When 10 centim. of the normal hyposulphite liquor are put into the flask, 100 parts of water must be added, the mixture slightly acidulated and colored with a few drops of tincture of indigo. Then if the solution to be tested is poured in, it behaves like the arsenious liquor, that is to say, the blue color is very persistent, and is only destroyed exactly where the chloruretted liquor falls: this enables us to ascertain exactly when the operation is concluded.

The hypochlorites in solution are neutre or alkaline, and the reac-

tion which they effect on hyposulphite of soda is only complete in slightly acid liquors. For this reason we recommend acidulating it. The acid which we add to the solution of hyposulphite does not immediately cause the deposition of the sulphur, when we operate with liquors as much diluted as we have indicated; and by operating rapidly, we obtain an exact estimation of the decoloring chlorine.

It would, however, be as well to make a first essay by operating as we have mentioned, and then to acquire certainty by means of a second operation, in which two-thirds of the liquor to be tested should be added before acidulating the liquor. There would thus be no fear of precipitating the sulphur, and no chance of error could occasion a doubt of the accuracy of the results of the operation.

The ease with which hyposulphite of soda absorbs chlorine is most remarkable, and we strongly recommend it as the best antidote in cases of poisoning by bleaching liquid and all the other hypochlorites, now in every one's hand.

It is likewise the most useful substance in counteracting the poisonous effects of bromine and iodine, and we are the more anxious to mention this point as hyposulphite is used in concurrence with bromine and iodine in photographic establishments, where cases of poisoning by these last two substances are the most likely to occur.—*Journal de Pharmacie et de Chimie*, Nov., 1855.

INORGANIC CHEMISTRY.

MEMOIR on the HYDRATED SILICA obtained by the DECOMPOSITION of the SILICATE of SODA of CALICO PRINTING MANUFACTURERS.

By M. E. MATHIEU PLESSY.

THE very great number of facts furnished to scientific study by industrial application is daily increased by the interest which, attaching to a useful product prepared on a large scale, very naturally excites the attention of chemists, and becomes to them the source of works eminent in science. Great examples are not wanting.

With the cyanides, indigo, acetic acid, stearine, &c., are connected the best studied reactions of organic chemistry, and the fundamental fact on which the developement of mineral chemistry reposes, is that the metals are the oldest products of industry. These examples have appeared to me to encourage an attentive examination of the silicate of soda, a product which has recently been much used in manufactories for a great purpose in printing, namely, washing out the gum, and as on account of its employment, this salt presented me the opportunity of undertaking some experiments, I pursued, with the care which a product of such important application deserves, the study of its decomposition by the acids, and in particular by acetic acid. I now present to the Academy the result of this study.

The silicate of soda on which I operated marked 20° of Baumé's barometer. It was obtained from M. Kestner's manufactory of

chemical products. When this silicate was mixed with commercial acetic acid of 8° B., the following was observed :—

When the acid is added to the silicate, an opaque jelly is formed, which is insoluble in an excess of acid. When, on the contrary, the silicate is poured into the acid, in the proportion of 10 volumes to 6 volumes, no jelly is immediately formed ; but after some hours' contact, the mixture solidifies, and the jelly which is then produced, slightly opalescent by reflected light, takes the form of the vessel in which it has been formed. When a gutta percha funnel is used for this purpose, nothing is easier than to obtain from it under warm water, and with a few gentle knocks, a jelly which retains the conical form of its mould.

When the jelly is detached from the funnel, it is introduced, always operating under water, into a sieve, which is afterwards left for six or eight weeks in a stone-ware vessel, the water of which is renewed from time to time. After this prolonged washing, this sieve is placed again in a warm locality, near the boilers of a steam engine, for example, where the dessication commenced is completed in the open air. Before the dessication, the jelly crushed between the fingers is unctuous to the touch, its fracture is conchoidal, and is thus distinguished from vegetable and animal jellies. After dessication in the way I have described, it is considerably diminished in volume, and is then presented in very large pieces, in the state of a transparent vitreous substance, which can no longer be crushed between the fingers, and so hard as to scratch glass. This substance is, however, only a glass with water for a base, which the application of a gentle heat sufficed for detecting. Already remarkable from this fact, it presents, besides, to the observation, physical characters unknown to silica, and for that reason, interesting. The following are these characters, one of which is accidental, and the other constant.

Thrown into sufficient water to cover it, the vitreous hydrate of silica decrepitates sometimes with noise, and small pieces are projected to a distance. This effect was not produced with all the samples of hydrate which I prepared. It was peculiar to some, to those probably which contained some bubbles of a compressed gas (carbonic acid) and perhaps a trace of acetate of soda aiding in the disaggregation,

Exposed to the light of the sun, this vitreous hydrate presents a curious phenomenon. It loses its transparency, becomes in some measure devitrified, undergoing a change analogous to that which arsenious acid undergoes spontaneously ; then, left in the open air during the night, it again becomes transparent.

However, this phenomenon, which may be reproduced indefinitely, is not dependent on light ; the heat developed by the insolation is the sole cause of it. Indeed, if the vitreous hydrate is introduced into a glass tube and exposed to the sun, the change does not take place ; but the small drops of water are attached to the interior of the tube, whilst the silica remains transparent. Therefore the air saturated with moisture, opposes the dishydration attaining the point at which the silica is devitrified. Again the devitrification is likewise effected

in air heated to the temperature of from 35° to 40° C. (95° to 104° F.) as indicated by the thermometer exposed to the sun by the side of the sample of hydrate, during the month of August.

The vitreous hydrate of silica is always apt to take up the water which it has given up in hot air, when it is restored to the ordinary temperature. This fact is proved of itself by the appearance of a corked flask containing a few pieces of hydrate; removed from the action of the sun, after having been exposed to it for a sufficient length of time, this flask is tarnished inside at the upper part by a cloud of condensed water; in the night this cloud disappears. Now, it is evident that it could only be absorbed by the hydrate of silica, because the vessel was closed.

Finally, and this last proof that this remarkable devitrification of silica is due to a partial loss of water, some opaque hydrate is enclosed in a corked tube, and we observed that when sheltered from contact with the air, this silica may be preserved in the opaque state, to which the vapor of water alone can restore its original transparency.

At any rate, in the laboratory, we may with advantage make use of the process which I have pointed out for the preparation of hydrated silica. Hitherto, mesotype, decomposed with hydrochloric acid, was employed for this purpose. The silicate of soda, a product much used in industry, it appears to me should be employed in preference to any other, on account of the facility of procuring it in large quantity.

The reproduction of the natural hydrates of silica, opal and resinite, seems susceptible of being tried by means of the vitreous hydrate, for it has happened to me in the course of my experiments, to obtain products which have been confounded in commerce with gum. Now, it is to be remarked that hyalite actually occurs, also like gum, in small transparent globuliform concretions.

The introduction of mineral coloring matters into the jelly of silica, such as oxide of uranium, the purple of cassius, and metallic gold, gave me glasses which by calcination increased considerably in lustre, but which, cracked by a too rapid loss of water, could not be devoted to any other purpose than printing on tissues, if we were always able to charge them with a sufficient quantity of coloring matter. At present I have not been able to fulfil this condition.

When the vitreous hydrate, freed from all foreign oxides, is calcined in the flame of a spirit lamp, with a double current, there remains a slightly opalescent quartz which occurs in small furrowed fragments, but without any appearance of crystallisation, whilst the silica, separated, not from a base as I obtained it, but from an acid with which it was combined, remains in the crystalline state. M. Daubrée, by the decomposition of the chloride of silicium obtained, indeed, a silica identical with hyaline quartz, and M. de Sénarmont, from a solution of silica in hydrochloric or carbonic acid, heated in close vessels at a high temperature, separated a crystalline sand.

I sought to determine the loss which the vitreous hydrate dried in the air and dried at 100° C. (212° F.) undergoes, and I have obtained only variable numbers, contrary to the results obtained by M. Doveri,

with a hydrate also resulting from the decomposition of an alkaline silicate by an acid.

According to the volume of the pieces of hydrate submitted to experiment, the loss was :—

For the hydrate dried in the air

23, 33, 35, & 32 per cent.

For the hydrate dried at 100° C. (212° F.)

13, 9, 5, & 5 per cent.

This last number applies to the common Hungarian opal. It was obtained with a hydrate maintained at 100° C. (212° F.) for four hours. From the above numbers, we can comprehend moreover, that by maintaining the vitreous hydrate for a longer or shorter time in the oven, we shall be able to reduce the quantity of water to any proportion we wish, and to fix it according to the results obtained by the analysis of the natural hydrates if researches should be undertaken with the view of reproducing these by means of the vitreous hydrate.

When the jelly of silica does not contain more than 35 per cent. of water, it has already the appearance of a glass. This number fixes for us the point at which the vitrification of silica by water commences, and seems to establish some analogy between the vitreous hydrate and ordinary glass, which is formed by a certain proportion of base, and is removed when a larger proportion converts it into alkaline silicate. Thus silica, when it is still in jelly, would correspond to the soluble silicate, and the hydrate containing not more than 35 per cent. of water would be definitively a glass similar to ordinary glass, and retaining like it, its physical aspect even when the proportion of base is reduced. Indeed, and which seems to justify the parallel here established, especially with the view of explaining the absence of a definite combination of silica and water, is that like ordinary glass, glass with water for a base, in certain circumstances which, moreover, are peculiar to it, undergoes a sort of devitrification, losing its weight, it is true, whilst ordinary glass, as the recent researches of M. Pelouze have shown, (see *THE CHEMIST*, New Series, Vol. II., 1854-5, p. 66), undergoes changes in itself, if we may so speak, and without abandoning anything to the action of heat.

Conclusions.

To sum up :—

1. The silicate of soda decomposed by acetic acid gives a transparent hydrate of silica.

2. This hydrate, submitted to the action of heat, undergoes a variable loss of water, which does not admit a definite concentration between water and silica.

However, the water disengaged in this case is in the state of combination, for its presence is detected only by the action of heat.

3. Finally, silica may affect the form of a vitreous hydrate, which the action of the sun or of a feeble heat devitrifies, and this fact is a new character for silica.

Comptes Rendus, No. 16, Oct. 15, 1855.

On the SOLUBILITY of VARIOUS METALLIC OXIDES and EARTHY CARBONATES, and on some REACTIONS PRESENTED by their SOLUTIONS.

By M. A. BINEAU.

Oxide of Silver.—Water dissolves about 1-3000th of its weight of oxide of silver. The solution of oxide of silver produces a double decomposition not only with the haloïd salts, but also with the phosphates.

Binoxide of Mercury.—Prepared either by the dry way, or by the humid way, it dissolves in from 20,000 to 30,000 times its weight of water. Its aqueous solution has no action on purified litmus, and water tinged with the reagent, and then slightly acidulated, retains its tint after having been charged with oxide of mercury; but a little saline water manifested in it an intense alkaline reaction.

Peroxide of Lead.—After long washings, I found no perceptible solubility in litharge, but it was different with the oxide produced by the humid way. My results as to its solubility agree with those of M. Bonsdorff, who estimated a 1-7000th quantity dissolved by one pint of water.

Dissolved oxide of lead, is capable like that of silver, of decomposing either haloïd salts, or oxy-salts, such as the phosphates, chromates, oxalates, carbonates, sulphates, nitrates, with liberation of alkaline oxide. But, in all the cases which I have observed, the displacement of one equivalent of alkali required several or at least $1\frac{1}{2}$ equivalent of oxide of lead. The easy production of caustic alkalies when their salts come in contact with oxide of lead, gives us reason to refer partly to the influence of the former the preservative effect which the alkaline compounds exert on this metal.

Oxide of Zinc.—I have found this oxide sometimes soluble and sometimes not appreciably so, the mode of production here exerting the same influence as in the case of oxide of lead. Moreover, water dissolves only scarcely one-millionth of its weight; it is sensible however, to purified litmus.

Protoxide of Iron.—Its solution, which was obtained by means of iron and pure water a little aerated, contained about 1-150,000th. It had a very strong ferruginous taste; it became turbid, peroxide being formed, as soon as it came in contact with the air, and before peroxidation it exerts an alkaline reaction on neutral or slightly acidulated litmus.

Magnesia.—With regard to solubility in water, it should be placed below oxide of silver, protoxide of lead and binoxide of mercury; that which is dissolved is reduced to one or two hundred thousandths of the weight of water; but the result is powerfully modified by the presence of carbonic acid.

Oxides of Alkaline Metals.—The proportions of each of them which one part dissolves is expressed by the following numbers: 1-780 for lime at 18° C. (64° 6' F.); 1-1500 at 100° C. (212° F.); 1-130 for strontia at 20° C. (68° F.); 1-29 for strontia; 2-3 for soda; and 1 for potassa.

Carbonate of Magnesia.—The subcarbonate of magnesia, after sufficient washings, ultimately dissolves in the proportions of only about 0·1 gr. per litre of water (or 1-10,000), whether cold or hot. A much higher degree of solubility has been attributed to it; an excess of carbonic acid was probably the cause of this.

The aqueous solution of subcarbonate of magnesia presents most of the reactions of the carbonates of potassa and soda.

Carbonate of Lime.—The carbonate of lime furnished nearly the same indications of solubility, both with cold and hot pure water, or in common water of which the natural subcarbonate had been destroyed by a long continued boiling. The proportion dissolved was from two to three hundred thousandths. M. Peligot has arrived, as regards the solution made without heat, at a result comprised within the same limits.

Carbonate of Strontia and Baryta.—Water dissolves about three hundred thousandths of the first, and four hundred thousandths of the second.

Comptes Rendus, No. 14, Oct. 1, 1855.

CONTRIBUTIONS to the HISTORY of ANTIMONY.

By M. J. LEFORT.

I. Purification of Antimony.

ALL chemists who have had occasion to employ metallic antimony, know how difficult it is to deprive it, when required in pharmacy, of the last traces of iron, lead, and especially of arsenic.

To these I must add bismuth, which I have found in considerable quantity in two samples bought by chance, and of the source of which I could obtain no distinct account.

The severe criticisms made on the processes pointed out in our chemical works for obtaining antimony in a state of absolute purity, suffice to show the difficulties presented by this apparently simple operation.

Of these modes of purification two are especially recommended to the attention by the names of their authors, MM. Wöhler and Liebig.

M. Wöhler's process is based on the transformation of metals into acids, by means of nitrate of potassa; it produces insoluble antimoniate of potassa and arseniate of potassa, which is removed by washing with water.

Berzelius, who repeated this operation, has pointed out that this process does not always furnish a produce quite free from arsenic, for the antimony when heated with charcoal and powerful blowing generally gave off a faint odor of garlic.

M. Liebig's process, which many authors prefer, is performed as follows:—

16 parts of antimony, 1 part of sulphuret of antimony, and 2 parts of dried carbonate of soda are mixed and melted in a Hesse crucible, the resulting metallic button is pulverised, then fused with $1\frac{1}{2}$ part of car-

bonate of soda; the product of this second operation is again reduced to powder, then fused a third time with only 1 part of carbonate of soda.

I have, after long practice, found that this operation only succeeds well when the antimony contains but little foreign metal. Another objection is the loss of matter; indeed, in the course of these three successive treatments a good deal of scoria are formed, which remove a considerable portion of antimony, and thus diminish the yield; on the other hand, MM. Mosander, Berzelius, Berlin, Bucholz and the elder Trommsdorff state that they have always found arsenic, even when the button had been even more frequently fused with carbonate of soda.

Instead of the dry way I have tried whether the humid way might not produce a more satisfactory result. I have observed, that by transforming antimony into antimoniate of antimony with nitric acid, it was possible, not only to dissolve the arsenic out in the form of arsenious acid, but also to cause the lead, bismuth and iron to pass equally into the state of soluble nitrates.

For this purpose I use the following method:—

Into a large porcelain capsule, placed under a chimney, I put 500 grammes of ordinary nitric acid, and project into it by degrees 250 grains of antimony reduced into a fine powder; each addition of metal causes abundant nitrous vapors; all the antimony passes into the state of insoluble and perfectly white antimoniate of antimony, and the foreign matters remain in solution in the supernatant liquid. The product of this operation is poured into a large vessel, precipitated and washed several times by decantation with water containing 1 per cent. of nitric acid; after eight or ten washings I dry the precipitate thoroughly, and add 30 or 40 grammes of powdered sugar. This paste is put into a Hesse crucible, and calcined at a red heat.

Below the scoria, will be found, after cooling, a metallic button which, tested with the blowpipe and with the ordinary reagents, gives no trace of any foreign matter, and especially of arsenic.

This process, which we should gladly see tested by those pharmacutists who prepare diaphoretic antimony, is very easily performed, and gives antimony which may be considered as being of absolute purity.

II. *Oxide of Antimony, or Antimonious Acid.*

Oxide of antimony ($\text{Sb}^3 \text{O}^3$.) possesses so little affinity for the acids or alkalies that the study of its various combinations has not as yet been made.

It has long been a question whether this oxide or acid (for it may be considered either) did not possess a state of peculiar hydration which would explain its solubility in certain agents.

All our authors speak of a monohydrate which appears when the chloride or sulphate of antimony are decomposed by the alkalis. On this subject I have arrived at the following result.

Whatever be the mode of precipitation employed, the soluble salts

of antimony give rise to an oxide which, when dried over sulphuric acid, is never hydrated. A very small quantity of water of interposition is found in it, whose quantity varies from 1 to 2 per cent; now these numbers do not form an equivalent.

The precipitation of the protochloride and emetic antimony by ammonia and the alkaline carbonates offers some peculiarities, to which I shall request attention for a moment.

In the first place, it is worthy of remark that all the substances which precipitate the oxide from these two salts do not act in the same manner. Thus, ammonia in excess, when poured into a solution of emetic antimony, gives rise after a few moments, to a heavy yellowish, crystalline oxide, insoluble in potassa and sulphuric acid. When dried over sulphuric acid, it becomes perfectly white. However long it may be washed it always contains a little tartaric acid, for when heated in a glass tube it takes a greyish tinge, and disengages the ordinary products of the decomposition of a non-nitrogenous organic acid.

With the neutral carbonates of potassa and soda, tartrate of antimony gives after a longer time, a voluminous precipitate if the solutions are very dilute, but after some time it becomes similar to the preceding.

All chemists know that the free and carbonated alkalies do not precipitate all the oxide of antimony contained in the tartrate.

By using proto-chloride of antimony, and operating with ammonia and carbonate of potassa or soda, the elimination of the oxide of antimony takes place immediately under the form of an abundant, very white and very voluminous precipitate, which, after remaining a few moments in the liquor or on a filter is converted into a heavy crystalline deposit of a pure white or slightly grey. This phenomenon, which has been already mentioned by M. Henry Rose, takes place in concentrated as well as in dilute solutions, it is explained by the great tendency of this oxide to take the prismatic or the octohedral form. The microscope detects in it, as in that obtained by burning antimony, these two forms united in exceedingly variable proportions.

Now, is the oxide of antimony in the first moment of its precipitation, that is to say, in the amorphous state, hydrated? We can only form an hypothesis on this subject, for the transformation takes place in so short a time that it is impossible to wash and dry the precipitate in order to analyse it.

Everything leads us to believe, however, that in this state it contracts a combination with water. In taking the crystalline form, this oxide would then be dishydrated in the same manner as the recently precipitated carbonate of lime, which is converted by time into arragonite.

It is certain that amorphous oxide of antimony dissolves as well in potassa as in soda, and we know that in the crystallised state it is insoluble, or only sparingly soluble, in the first of these alkalies, even with heat. Sulphuric and hydrochloric acids also present a well marked difference of action. Sulphuric acid, which very difficultly

dissolves the crystallised oxide, very readily effects the solution of that which is amorphous; with hydrochloric acid, the solution is also more rapidly effected.

The oxide of antimony, precipitated by the means which we have just made known, or in a boiling liquor, does not always possess the same tint.

Thus the proto-chloride of antimony and emetic, treated with ammonia, give after dessiccation a perfectly white precipitate. If we replace the ammonia with carbonate of soda or potassa, and if we operate cold, the precipitate is greyish white; with heat, it is yellowish white.

The oxide precipitated from its combination with the alkalis by the dilute acids is likewise anhydrous, without any well determined crystalline form, and acts like the foregoing when put in contact with chemical agents.

What is now the best process for obtaining the oxide of antimony adapted for the manufacture of emetic and for medical use? M. Baruel assures us, that oxide of antimony, intended for medical use and prepared by decomposing the powder of algaroth with bicarbonate of potassa, always retains a small quantity of chloride of antimony.

In order to obviate this inconvenience this chemist recommends precipitating emetic by ammonia with heat. We have seen, indeed, that the powder of algaroth, on account of its extreme insolubility was more difficultly decomposable either by ammonia, or by the carbonated alkalis than the butter of antimony; therefore, we recommend, for obtaining an oxide fit for the two purposes we have mentioned, to pour a solution of proto-chloride of antimony into an excess of caustic ammonia, and to maintain the mixture for twelve hours at the temperature of 50 to 60° C. (122 to 140° F.) By this means, the oxide, after a sufficient washing, is totally deprived of chlorine; it costs a moderate price, and finally dissolves easily in cream of tartar.

III. Action of nitric acid on antimony and its oxide.

Antimony, in presence of nitric acid, furnishes oxide of antimony or antimonious acid, according as the metal is in fine powder and the acid concentrated or dilute.

If the action alone is effected, in a word, if the disengagement of the nitrous vapors is not powerful, all the antimony passes to the state of oxide of antimony or antimonious acid; in the contrary case, we obtain a mixture of these two compounds, designated by the name of antimoniate of antimony.

All authors say that the liquor which has served for oxidising the antimony contains traces of basic nitrate of antimony; it was in endeavoring to isolate this salt for the purpose of analysing it that I convinced myself how much the processes hitherto indicated for purifying antimony left to be desired.

Indeed, every time I operated with metal, the purity of which I doubted, I obtained a few decigrammes of a cold crystallised salt, which consisted sometimes of a mixture of nitrate of lead and nitrate of bis-

muth, and most frequently of nitrate of lead with traces of nitrate of iron; but with chemically pure antimony, nitric acid after volatilisation left no residue.

I sought all possible means of obtaining a definite combination of nitric acid with the oxide, and my results were always negative. However, some chemists assert that by dissolving the oxide of antimony in fuming nitric acid, a nitrate is obtained which is represented by the formula



All the varieties of oxide of antimony which I have made known above, put in contact with concentrated nitric acid, disengage nitrous vapors; a certain quantity of antimonic acid is formed, but the liquor does not retain any oxide.

If we continue the contact for several days, we remark that the oxide of antimony increases in volume. This precipitate, exposed on a dry brick and in a drying apparatus, gave by analysis most various numbers which could not be formulised. From this, I conclude that it is a mixture rather than a combination; moreover, if it be treated with water, all the nitric acid is eliminated, and we obtain a mixture of oxide of antimony and antimonic acid.

As recently precipitated or amorphous oxide of antimony dissolves in hydrochloric and sulphuric acids more easily than when it is crystallised, I wished to ascertain, whether nitric acid presents the same reaction.

Indeed, the first portions of oxide which we add are speedily dissolved, but are precipitated a few minutes after, and the liquor contains no more oxide of antimony.

From these facts we think that we are warranted in concluding that the combinations of nitric acid with oxide of antimony are still to be found.—*Journal de Pharmacie*, August, 1855.

On some new PROPERTIES of freshly calcined WOOD CHARCOAL.

By M. MORIDE.

THE deoxidising power of wood charcoal is well known, when used in the dry state and under the influence of an elevated temperature; but I do not know that any one has mentioned it as reducing metals in the midst of neutral, alkaline, or acid liquors, neither am I aware that any one has observed that in contact with a dilute and alcoholised acid, freshly calcined wood charcoal caused the formation of ether. I am continuing this study, but I have determined to make known the results of my first experiments.

Coke, charcoal from lignites, animal and bone charcoal, do not produce the effects of which I am about to speak.

1st. When incandescent wood charcoal is plunged directly, or after being extinguished with cold water, into an acid solution of sulphate of copper, the metal is gradually deposited upon the charcoal until it may be entirely recovered. In neutral or alkaline liquors the reaction is not so well performed. In Barreswill's liquor, for instance, the

copper deposited upon the charcoal has a very beautiful iridescent appearance. When nitric acid, hydrochloric acid, or sulphuric acid is used to acidify the solutions, the effect is the same, only that it is clearest with sulphuric acid.

2nd. I have observed that the metallic salts of organic acids are less easily decomposed than those which contain mineral acids.

3rd. The solutions of silver in nitric acid, whether neutral or acid, and chloride of silver dissolved in ammonia, are easily decomposed by freshly calcined wood charcoal. The silver is soon seen to cover the charcoal in the most beautiful manner; it sometimes appears crystallised.

4th. Copper may, by this same means, be precipitated from ammoniacal solutions; but if these solutions likewise contain silver, the latter will be first reduced.

5th. Finally, incandescent wood charcoal plunged in Fowler's solution, acidified with sulphuric acid, produces a very agreeable ether which I intend to examine. It will be easy to make in this way, by varying the acids, nitric, acetic, sulphuric ethers, &c.

6th. Zinc, iron, platinum, lead, and mercury may be precipitated by wood charcoal, but they re-dissolve in acid liquors; this does not occur at all with silver, and with copper not until twenty-four hours after the operation.

Comptes Rendus, No. 16, October 15, 1855.

On the DECOMPOSITION of the NITRATES by CARBON.

By M. VOGEL, Jun.

IN a Memoir presented to the Academy of Science at Munich, M. Vogel, jun., has described his numerous experiments on the decomposition produced in a mixture of the nitrates with charcoal at different temperatures.

He gives the following conclusions as the result:—

1st. The oxidation of the charcoal when mixed with nitrate of potassa is incomplete and without ignition at a temperature slightly above the fusing point of nitrate of potassa.

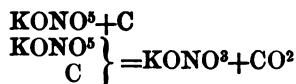
2nd. The charcoal passes, by this process of oxidation alone, to the state of carbonic acid, and oxide of carbon gas is never formed.

3rd. The nitric acid decomposes under these circumstances into nitrogen gas, gaseous oxide of nitrogen and nitrous acid.

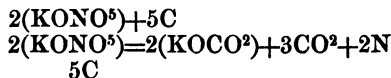
4th. According to the elevation of the temperature and according to the relative quantities of the charcoal and nitrate of potassa, the potassa is found in the residue after the decomposition in the state of nitrate and carbonate of potassa mixed with undecomposed nitrate or

nitric acid. The decomposition takes place in the following

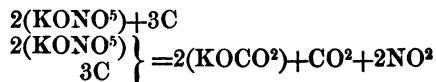
a. In the residue is found nitrate of potassa.



b. In the residue is found carbonate of potassa ; the gaseous mixture contains carbonic acid and nitrogen gas.



c. The gaseous mixture contains carbonic acid and gaseous oxide of nitrogen.



6th. A current of oxide of carbon gas does not decompose the fused nitrate of potassa, but it passes into the state of carbonic acid when disengaged in the *status nascens*, that is to say, from a mixture of oxalate of potassa and nitrate of potassa, at a temperature at which the oxalate of potassa, heated without nitrate of potassa, does not undergo the slightest decomposition.

7th. To procure pure nitrate of potassa it is preferable to add charcoal to fused nitrate of potassa, instead of bringing the nitrate of potassa alone to a red heat, the process which has hitherto been employed.

8th. To obtain small quantities of carbon by the formation of carbonate of potassa, by fusing an organic substance with nitrate of potassa, it is necessary to avoid an excess of nitrate of potassa, because in this case only nitrite of potassa is produced and no carbonate.

Journal de pharmacie et de Chimie, Nov. 1855.

On TRIBASIC NITRATE of LEAD.

By M. VOGEL Jun.

BERZELIUS mentioned a tribasic nitrate of lead containing six equivalents of water. The tribasic nitrate that M. Vogel has just discovered contains but three, and it is so far insoluble in water that it may in some cases serve as a character of nitric acid, as we have not hitherto found an insoluble salt formed by this acid.

This salt is formed by pouring the concentrated solution of a nitrate into tribasic acetate of lead ; it is precipitated as a glutinous mass almost insoluble in cold water, and sparingly soluble in water containing saltpetre.

If instead of using concentrated solutions, diluted solutions are employed, the precipitate formed is granular and crystalline. The glutinous precipitate loses its viscidness after some time and becomes brittle and crystalline. Hot water dissolves it and then leaves it under the form of lumps composed of agglomerated needles.

Although free from copper, these crystals have a greenish tint when seen in large masses. At 212° F. in a current of dry air, they lose a portion of their water, but only lose the remainder at a temperature of 401° F. (205° C.) *in vacuo*.

1 part of this anhydrous salt dissolves in 11.3 parts of boiling water and in 127.3 parts of cold water. 1 part of the hydrated salt only requires 10.5 parts of boiling water and 119.2 parts of cold water.

When subjected to calcination this basic nitrate first leaves a residue of minium, which changes into yellow oxide (massicot) by a still stronger calcination.

The formation of this basic salt may lead to errors in analysis which it will now be easy to prevent. It is often requisite to decompose organic matters with nitric acid, then neutralise and precipitate by acetate of lead for the purpose of estimation. The conditions for the production of tribasic nitrate of lead are thus fulfilled, and as this salt is but sparingly soluble, it will remain mixed with the organic precipitate and will be considered to form a part of it if we do not endeavor to eliminate it.

Neues Repertorium and Journal de Pharmacie et de Chimie, Nov., 1855.

INDUSTRIAL CHEMISTRY.

PROCESS for the FORMATION of a very solid CEMENT by the ACTION of a CHLORIDE or OXIDE of ZINC.

By M. SOREL.

I HAVE the honor of submitting to the judgment of the Academy, a new chemical process which I have discovered for forming a mastic or cement of great solidity. This cement is a basic oxy-chloride of zinc, it is obtained by moistening oxide of zinc with the liquid chloride of the same base, or in another chloride isomorphous with the chloride of zinc, for example, protochloride of iron, manganese, nickel, cobalt, &c. These chlorides may be replaced with hydrochloric acid.

We obtain a cement so much the harder as the chloride is more concentrated and the oxide more heavy. I employ washed residues arising from the manufacture of white zinc, or else I calcine to redness ordinary white zinc. I employ chloride of zinc marking from 50 to 60 degrees of Baumé's areometer, and in order that the cement may set less quickly, I dissolve in the chloride about 3 per cent. of borax or sal-ammoniac, or else I calcine the oxide, after having moistened it with water containing a small quantity of borax.

The mastic or cement obtained by the combination of the above substances may be run into moulds like plaster; it is as hard as marble; cold, moisture and even boiling water are without action on it: It resists 300° C. (576° F.), and even the most powerful acids attack it only very slowly.

The new plastic matter is not expensive, but its cost may still be considerably diminished by being mixed with the oxide of zinc, metallic, silicious, or calcareous matters, such as iron filings or borings,

iron pyrites, blende, emery, granite, marble, and all hard calcareous matters. Soft matters, such as chalk and ochre, will not do.

The highest and most varied colors may be given to the new cement, which allows of its being used for tables and mosaic pavements of great hardness and beauty. M. Fontenelle, the sculptor, has used it with success for this purpose, and mosaics formed with the new cement may be seen in the choir of St. Etienne-du-Mont, at Paris.

This cement may also be employed for making moulded objects of art, such as statues, statuettes, medallions, bas-reliefs, &c. It is also perfectly suitable for making ceilings, and, which proves the insolubility of the new cement, is, that several good dentists of Paris have employed it for several years for filling decayed teeth, and even for cementing the pieces of a set of teeth; but the most important application of this new matter would probably be its employment for painting buildings, in place of oil paint.

To form this paint, the pure or colored oxide of zinc is moistened with water and a little size, and this paint is applied like ordinary size paint, and when the desired number of coats has been given and the last coat is dry, we pass over, by means of a brush, a little chloride of zinc, of 25 to 30 degrees of Baumé. It may afterwards be scoured with pumice, and varnished like oil-painting. This paint is very solid, and without odor: it dries instantly, and it has the advantage of being eminently antiseptic, owing to the chloride of zinc.

Manifest advantages would result from the substitution of oil in paint by hydrochloric acid, or by chlorides obtained with that acid. Indeed, instead of employing a considerable portion of territory in the cultivation of oleaginous plants, this cultivation may be replaced by that of cereals and other plants, useful for the nourishment of man and cattle. Hydrochloric acid does not proceed from the soil; it is one of the products of the decomposition of common salt, which is obtainable at small cost from the sea or from the bowels of the earth, inexhaustible sources. The other product of common salt is soda. From the employment of large quantities of hydrochloric acid, we should have, at a low price, considerable quantities of sulphate of soda and carbonate of the same base, which must lower the price of glass and soap.*

The chemical composition which I have the honor to present to the Academy has at least the merit of novelty. It is a raw material which I introduce to science and industry, and, as such, I think it worthy of examination by the Academy.

Comptes Rendus, No. 19, Nov. 5, 1855.

*All branches of industry in which common salt is a primary matter or to which it contributes hydrochloric acid or soda or any of the matters which are dependent on these for their formation, must be retarded so long as common salt is subject to the present heavy duty. This duty at the present moment prevents the introduction into France of most important industrial processes, which would give employment to thousands, and generally enhance the wealth of that great country. Perhaps the present enlightened ruler of France may some day confer on his people the great boon of remitting the tax on salt, and thus open the door to increased prosperity. We are convinced that, were he to do so, the loss to his revenue would soon be made good by the impetus thus given to all branches of manufactures.—EDITORS.

ELECTRO-CHEMICAL PROCESS of ENGRAVING.

By M. G. DEVINCENZI.

THE author has devoted himself, for some years, to a series of researches on the art of printing, reproducing designs by engraving in relief and printing characters. The following is a description of his method.

The metal best adapted for this kind of engraving is zinc. It is employed in laminated plates which are ground with sifted sand, and the design is made on it with ink and the lithographic crayon. The design being executed, the plate is prepared as if it were to be used for lithographic drawing. For this purpose it is steeped for a minute in a decoction of nut-galls. It is washed with pure water and covered with a weak solution of gum arabic. The plate is moistened with a sponge, the design is effaced with essence of turpentine, and a lithographic cylinder endued with a varnish is rolled over it. This varnish accurately covers all lines made by the designer. The varnish should have the following qualities:—1. Of not injuring the design; 2. Of adhering strongly to the plate; 3. Of not being attacked by the chemical agents employed for engraving.

The varnish known in England under the name of "*Brunswick black*," mixed with essence of lavender, is preferable to all others. This varnish is composed of asphalte, boiled linseed oil, litharge and turpentine. When the varnish is dry, the zinc plate is put in communication with a copper plate at the distance of 0.005; after which, they are steeped in a solution of sulphate of copper marking 15 degrees; a voltaic pair is thus formed; the sulphuric acid resulting from the decomposition of the sulphate of copper dissolves all the parts of the zinc which are not covered. More or less depth is given to the engraving, according to the kind of design. Crayon designs are generally engraved in four or five minutes, and those with the pen in six or seven minutes.

Sulphate of copper does not produce *any alteration* in the most delicate drawings, and does not act on the varnish.

This method of engraving may be applied to all the other processes, by means of which a design may be reproduced. We may draw on paper and afterwards transfer the design on to plates. The impressions of lithographic stones, copper and steel plates, may be transferred. These machines may be employed on zinc as well as on lithographic stones for producing flat tints. The process is likewise applicable to *printing characters*. It suffices to have a page of a book transferred to a plate of zinc to make a stereotype of it.

This manner of engraving will replace the ordinary stereotype. By means of this process, we may transfer the page of a book, when it is being printed, on to very fine sheets of zinc; and from the latter to thicker plates in order to engrave them as often as they have to be reprinted. Hence results great economy in composition and paper, since there is no need to have large impressions. A copy on very thin sheets of zinc does not cost more than a copy taken on good paper.

I may add, finally, that the stereotypes may be applied to two other means of typographic reproduction. It is not difficult to transfer from an old impression on to metallic plates. We may thus have other stereotypes of old books.

Comptes Rendus, No. 19, Nov. 5, 1855.

PROCESS of PREPARING ALKALINE STANNATES.

By M. HAEFFELY.

LITHARGE or minium is digested in a metallic vessel with a caustic lye containing about 22 per cent. of soda; when the solution is effected, it is treated with tin in grains: the lead immediately separates in the spongy state, whilst an equivalent proportion of tin is dissolved, and forms stannic acid, which combines with the soda, forming stannate of soda. The following are the proportions to be employed:—

	Kilogr.
Tin	8
Soda lye of 1·35 density	22·500
Litharge	35—40, or
Minium	27

When the solution of tin is effected, the lead is allowed to deposit, and the liquid is decanted. The residue is washed, and the washing waters are set apart for a further operation.

The lead which has been displaced may likewise be used in a subsequent operation; for that purpose, it is heated to redness on an iron plate in order to oxidise it: according to the degree of temperature, litharge or minium will be obtained.

The stannates of potassa and ammonia may be obtained in an analogous manner.

Journal für praktische Chemie.

AGRICULTURAL CHEMISTRY.

REPORT on a WORK of M. GEORGES VILLE, the object of which is to prove that the NITROGEN of the ATMOSPHERE is assimilated in VEGETABLES.

By MM. DUMAS, REGNAULT, PAYEN, DECAISNE, PELIGOT and CHEVREUL, Reporter.

THE Academy has charged us with the examination of a work according to which M. Georges Ville has concluded that the elementary nitrogen of plants does not arise solely from the ammonia contained in the manures, the atmosphere and rain, but also from the free nitrogen of the air. This simple enunciation will cause the importance of the subject treated by M. Ville to be felt, and the contrary opinion held by distinguished men of science enhances its interest.

If it were necessary to show the difficulties of works relative to the question of the origin of nitrogen in vegetables, it would suffice, doubtless, to make a rather brief summary of these works, either that their authors had directly investigated this origin, or were occupied with it only in connection with works undertaken with another object.

Priestly, in submitting plants to the contact of different gases, thought that he observed the absorption of nitrogen by some of them, and principally by the *Ephelobium hirsutum*, (1779).^{*} Priestly had ascertained, on the 17th of August, 1770, that a mint restored the purity of the air which had been viciated by the combustion of a taper or by the respiration; (*Observations on Different kinds of Air*); but he had not observed the necessity of solar light to this purification. It was Ingenhousz who discovered this, in 1779; and, like Priestley, he thought that plants absorbed the nitrogen gas with which they are put in contact.

But Theodore de Saussure, in his numerous researches on vegetation, never having observed this absorption, combatted Priestley's opinion, as Senebier and Woodhouse had already done.

Theodore de Saussure attributed the origin of the nitrogen of vegetables to the ammonia of the manures, the air and rain, and to that of several other compounds and of other soluble nitrogenous compounds: he made moreover, the important remark that the plants which vegetate in an atmosphere not renovated with the aid of a small quantity of pure water, did not acquire nitrogen; only, the portions developed in this condition absorb nitrogen from the parts formed prior to the experiment. (*Recherches sur la Végétation*, page 207).

M. Boussingault presented to the Academy on the 22nd of January 1838, a Memoir, the object of which was to demonstrate that the nitrogen of the air may be *assimilated in plants during vegetation*.

He made two series of experiments on trefoil. In the first series, the plants vegetated in moistened calcined sand, contained in porcelain vessels deposited in a pavilion situated at the end of a large garden.

After a vegetation of three months, the weight of the dried crop, the ash being deducted, was 4.106 gr.; the weight of the seeds, the ash being deducted, was 1.586. The crop had therefore gained : : 1 : 2.59. The quantity of nitrogen of the crop exceeded that of the seeds by 0.042 gr.

M. Boussingault, fearing that the excess of nitrogen might be attributed to dust transmitted to the trefoil by the air, and acting like a nitrogenous manure, proceeded to the second series of experiments. He operated in an apparatus furnished with an aspirator, in which the dust was stopped before arriving in the bell-glass. The vegetation did not last beyond the month of October. This time, the excess of the nitrogen of the crop over that of the seed was only 0.008; but M. Boussingault considered this result confirmatory of the first.

* Experiments and Observations on Different Branches of Physics.

In a second Memoir, M. Boussingault showed that the same result was obtained with peats as with trefoil.

Liebig, in 1839 and 1840, denied the fixation of the nitrogen of the air by plants; conformably to the opinion of de Saussure, he regarded ammonia as the source of nitrogen in vegetables. Evidently, in his eyes, this compound is to the source of nitrogen, what carbonic acid is to that of carbon.

From 1851 to 1855, M. Boussingault has devoted himself to new experiments on the origin of nitrogen in vegetables, and this time he concluded that plants do not increase the quantity of nitrogen of their seeds, when they are developed in confined atmospheres from which ammonia and nitrogenous manures are excluded. In fact, he returned to the opinion of Th. de Saussure and Liebig. The following is a summary of his last two memoirs.

First Memoir. He describes an apparatus in which a plant lives in an atmosphere which is not renewed. He insists on the necessity, for determining the quantity of nitrogen, of submitting the entire crop to analysis. He remarks that he has always obtained a number of plants equal to the number of seeds which he sowed.

He concludes from a first series of two experiments made in 1851, and from a second series of these experiments made in 1852, and from a third series of experiments made in 1853, that nitrogen gas is not assimilated during the vegetation of beans, oats, cress and lupins (See THE CHEMIST New Series, Vol. i, 1853-4, pp. 620, 666, 731).

Second Memoir (See THE CHEMIST, New Series, vol. ii, 1854-5, p. 173). M. Boussingault describes an experiment, the object of which was to show that the vegetation of a plant may be normal in a limited atmosphere when the soil contains the elements necessary for vegetation.

Finally, he investigates whether, in an atmosphere continually renewed, there is a fixation of nitrogen gas. He details the precautions which he took, the selection of the soil and ashes, the purification of the air, and of the carbonic acid, the purity of the water, &c.

He concludes, from seven experiments on the lupin, dwarf beans, and garden cress, that there is no fixation of nitrogen.

M. G. Ville commenced his researches on the origin of the nitrogen of plants in 1849, and he has never ceased to study the subject.

In 1850, in announcing to the Academy that he had obtained a beautiful vegetation in a sterile soil, he dwelt on the probability of the fixation of nitrogen by vegetables in order to form their quarternary organic proximate principles, and he invited those savants who might be interested in the subject, to inspect, in the Garden of the Carmelites two apparatus serving for comparative experiments.

Plants vegetated in a glass case into which the atmospheric air arrived by means of an aspirator, mixed with 3 or 4 per cent. of carbonic acid.

A second apparatus, absolutely similar to the first, and placed beside it, but containing no plants, served for estimating the ammonia of the atmosphere which arrived in the bell glass, and gave consequently that which reached the plants of the first case.

Well, by adding the nitrogen of this ammonia to the nitrogen contained in the seeds before their germination, the quantity was smaller than that of the nitrogen of the plants produced from those seeds. Therefore, the excess must arise from the nitrogen which had passed into the apparatus in the state of atmospheric air.

The experiment of which we speak lasted a year. But the author did not communicate its results to the Academy until 1852, after having verified them in an apparatus fitted up at Grenelle*, but this time the air passed into the glass case containing the seeds under experiment only after having been deprived of its ammonia.

M. Ville published in 1853 his experiments in a small volume, with the fullest details.

In the first part of his work, he described his experiments for the estimation of the ammonia of the air.

In the second, he describes those which led to the fixation of the atmospherical ammonia by the plants.

The third and fourth are devoted to the influence of vapors of subcarbonate of ammonia on vegetation and of its employment in greenhouses.

Finally, an Appendix contains everything relating to the construction of the apparatus, as well as the methods and processes which he followed.

In fine, M. Ville concluded :

1. That in a stagnant atmosphere the quantity of nitrogen of a crop presents at most only the nitrogen of the seeds.

In this he partakes the opinion of de Saussure and M. Boussingault himself.

2. But that in operating the development of seeds in a large or small glass case, in which the air, deprived of ammonia, is slowly renewed after having received about two volumes of carbonic acid gas, to every ninety-eight volumes of air, the result differs altogether from the preceding, for, in the first case, the weight of the seed is to that of the dried crop as 1 : 1.5, 3, 1, whilst in the second it may be as 1 : 40 and more.

As we have seen, M. Boussingault having communicated to the Academy from 1851 to 1853 researches in which he came to the conclusion opposed to M. Ville's opinion, that plants do not fix the nitrogen gas of the atmosphere, this young *savant* presented to the Academy a note (See THE CHEMIST, 1852-3, page 264), in which he, in his turn, combatted M. Boussingault's opinion, supporting himself with new facts, especially with that of the identity of weight of the crops obtained by making use, on one hand, of distilled water deprived of nitrogen, and, on the other, of rain water. He offered to the Academy to repeat his experiments before a committee.

The committee to which M. Ville's work was confided, decided on describing an experiment which M. Ville was performing at the

* We have seen M. Ville's apparatus in his garden of Grenelle, near Paris, and can testify to the great care which this talented chemist has taken to avoid the chances of error, and to the great beauty of growth of his plants—EDITORS.

Museum of Natural History, assisted by M. Cloez, Preparator of the Course of Chemistry Applied to Organic Bodies. It took all the precaution which it considered necessary for ascertaining the truth. But, in so complicated an experiment, which was carried on for entire months in the open air, and on which circumstances have been less favorable on account of frequent variations of temperature, winds and violent storms, it must not be matter of surprise if this report should still leave something to be desired on some points: however, nothing of what has occurred will be dissembled.

The apparatus which M. Ville fitted up at the Museum resembled that which he described in his work.

A glass case of the capacity of 150 litres received three earthenware pots perforated with holes. The bottom of each of them was furnished with large pieces of brick covered with a layer of sand of Etampes, in default of sand of Fontainebleau, which is the most suitable for the experiment.

In this sand were placed a certain number of cress seeds. The pots were placed over a layer of water which, by capillary attraction, penetrated into the sand.

The glass case communicated on one hand with an aspirator of 500 litres, and on the other with the atmosphere and a reservoir of carbonic acid gas. But the air did not arrive directly into the case, it passed into two flasks filled with concentrated sulphuric acid, then into two flasks filled with pumice impregnated with concentrated sulphuric acid; finally, into two flasks containing carbonate of soda. It was on issuing from these flasks that it received 2 volumes of carbonic acid gas to every 98 volumes of air.

The air was renewed in the apparatus eight times in every twenty-four hours.

The distilled water with which the sand was moistened was tested, as we shall see, before and after the experiment. It was supplied from the laboratory of the Museum, and had been prepared by M. Cloez.

The pots, the pieces of brick and the sand, after having been heated to redness, were submitted to examination before being introduced into the glass case, in order to ascertain whether they contained ammonia. 40 grammes heated with soda-lime did not yield any perceptibly to dilute sulphuric acid.

Finally, the ashes of cress seeds were added to the sand.

Before explaining the results of the experiment commenced on the 4th of August, 1854, and terminated on the 12th of October, in the same year, we will say a few words concerning a previous experiment, commenced on the 18th of July, which an accident stopped twelve days afterwards.

On the 18th of July, four pots containing cress seeds were put into the glass case. These pots rested on a sheet of lead placed at the bottom of the case. This sheet was covered with a layer of white zinc mixed with drying oil and essence of turpentine. Unfortunately, the latter not being completely evaporated, it produced in the atmosphere of the case a sufficient quantity of vapor to prevent the germination

of most of the seeds and to kill those which had begun to germinate.

We ascertained, by a direct experiment, that by putting into a limited atmosphere a rag impregnated with a few drops of essence of turpentine, germination is prevented, and seeds which have begun to germinate are killed. We made the experiment, and afterwards found that Huber of Geneva had observed the same fact.*

To remedy this accident, the sheet of lead was removed, and on the tinned iron bottom of the case was applied a layer of wax, melted with linseed oil, and with the addition of litharge; then we run on successively five layers of white wax weighing together three kilogrammes. Unfortunately, there was manifested during the experiment, in the water which was in contact with the fatty matters at the bottom of the case, a perceptibly rancid odor and a bitter taste, which continued until the end of the experiment, although M. G. Ville replaced this water at various periods of the experiment, as we shall see. All the waters which came out of the receiver were kept for examination at the end of the experiment.

August 4.—Three pots were placed in the case; a large one, No. 1, and two small ones, Nos. 2 and 3.

No. 1, besides the pieces of brick at the bottom, received 2,000 grammes of sand of Etampes, and 6 grammes of ashes of cress seed; 158 seeds of cress, weighing 0.319 gr., and representing 0.0099 gr. of nitrogen, were sown in it.

No. 2, arranged like the foregoing, received 500 grammes of sand and 2 grammes of ash; 60 cress seeds, weighing 0.1275 gr., and representing 0.0038 of nitrogen, were sown in it.

No. 3, arranged like the foregoing, received 500 grammes of sand and 2 grammes of ash; 60 cress seeds, weighing 0.1245 gr., and representing 0.0039 of nitrogen, were sown in it.

August 7.—Many seeds had germinated.

August 8.—Water removed from the glass case by means of a stop-cock placed at the bottom of the case. Fresh distilled water introduced.

9 and 10.—Water renewed; 1 gramme of ash of cress seed added, and the water renewed.

11.—The case was opened, in order slightly to sink No. 1 and to raise Nos. 2 and 3. Dry sand was added.

The germination was satisfactory, but more beautiful in Nos. 2 and 3 than in No. 1. Water renewed.

14, 15, 16, and 17.—Water renewed each day.

19.—Water renewed. The case was opened, and the lower leaves began to turn yellow on several stems.

21.—Vegetation better in Nos. 2 and 3 than in No. 1.

26.—Water renewed. Plants of No. 1 unhealthy; those of No. 2 very fine; those of No. 3 fine.

* Memoirs "On the Influence of the Air, and of Various Gaseous Substances in the Germination of Different Seeds." By F. Huber and J. Senebier, p. 99. Paschoud; Geneva.

Sept. 4.—Plants of No. 1 very unhealthy ; those of No. 2 very fine, beginning to shoot up ; those of No. 3 mediocre.

13.—Water renewed for the tenth and last time. Plants of No. 1, vegetation defective ; those of No. 2 very beautiful, flowering ; those of No. 3, mediocre flowering.

14.—Plants of No. 1, a few flowers ; plants of No. 2, seeds beginning to form ; those of No. 3, very general flowering.

Oct. 8.—The vegetation was over in the best grown plants.

12.—The experiment terminated.

In order not to interrupt the detail of the phenomena, which appeared in the glass case, we have not mentioned a second experiment, the idea of which was suggested to M. Ville by M. Peligot. This idea was to interpose, between the case and the aspiratory apparatus, a bell glass of about 25 litres capacity, with a pot of cress seed, No. 4.

On the 30th of August, we placed one zinc plate, supported by a small table, a vessel containing $1\frac{1}{2}$ litre of distilled water which communicated with the atmosphere only by means of a glass tube the end of which, drawn out in a lamp, was bent and turned upwards. The water of the vessel arrived in the pot No. 4, arranged like the pots Nos. 1, 2 and 3. Over the pieces of brick there were 700 grammes of sand and 2 grammes of cress ashes, in which were sowed 100 seeds of this same plant, weighing 0.206 gr. and representing 0.0063 of nitrogen. The pot was covered with a bell-glass of 25 litres capacity, and the latter was fixed and remained on the zinc plate by means of a cement, so that, until the 17th of October, when the experiment ended, the interior of the bell-glass was not in communication with the surrounding atmosphere otherwise than by means of the air of the glass case, and this air, before reaching it, had passed through a flask containing concentrated hydrated sulphuric acid and into a flask containing carbonate of soda.

On the 5th of September M. G. Ville placed a second bell-glass, covering a pot of sand containing seeds, with the pot, No. 4. An accident having interrupted this third experiment, we shall say no more about it.

We return to the vegetation of pot No. 4, placed under the bell-glass on the 30th of August.

Sept. 4.—The seeds are healthy ; most of them begin to germinate.

9.—Vegetation uniform and satisfactory.

13.—The leaves are well developed.

30.—From the commencement of germination, the vegetation during the first fifteen days, was very active ; after this, it became slower, and the cotyledons and first leaves turned yellow.

Oct. 3.—The vegetation had recovered its activity ; the plants are disposed to shoot.

17.—The plants were in flower.

The experiment ended here, we shall speak of its results after having given those of the first experiment.

(To be continued.)

FORENSIC CHEMISTRY.

ADULTERATION of BREAD.

THE following letter has been addressed to the Editor of *The Times* by Dr. Normandy. We consider it well worthy of the attention of our readers, such of whom as are competent will, we trust, examine the bread and other commodities sold in their neighborhoods, and expose the vile frauds committed. If all chemists would do this, adulteration would soon be powerfully checked.

To the Editor of the Times.

Sir,—*The Times* of the 30th of last month contains a short account of the prosecution of a miller who was convicted at the Bromsgrove petty sessions of keeping alum for the purpose of mixing with the flour ground at his mill, and was accordingly fined what is, I believe, the minimum penalty—namely, 5*l.* and costs. It appears, however, that some considerable trouble must have been taken to bring about that conviction; and, seeing that the act of Parliament which regulates the matter applies with equal force to bakers, either journeymen or masters, it is somewhat astonishing that the police superintendents or others should have to take the circuitous course of procuring warrants to search for that which is exposed for sale in open daylight, and which can be procured at once, and at any time from any baker, at least in London, by simply purchasing a half-quartern loaf of bread. I am informed, however—but I can scarcely credit it—that the act of Parliament (1st and 2nd George IV., chap 50) cannot be enforced against bakers, who, it is said, evade its provisions by not keeping the adulterating substances on their premises, but sending the said substances to the mill to be mixed with the flour; and this, indeed, may have been the case in the present instance. Yet, I have reasons to believe that the introduction of alum into bread takes place, also, at the baking-house. I know, moreover, as a fact, that wholesale druggists, or, rather, drysalters, keep for the use of bakers a “stuff” which consists of pulverised alum mixed with a certain quantity of common salt, and that the mixture is sold and delivered at the bakers’ shops; the quantity of alum thus used varying from about 25 grains to as much as 500 grains in a quartern loaf. In my evidence before the Select Committee of the House of Commons on the Adulteration of Food, &c., I stated that I had actually found crystals of alum the size of a pea in that part of the loaf which is neither crust nor crumb, but has a somewhat horny appearance at the edges. This statement, which has been denied in certain quarters, but which I am in a position to prove by two witnesses, has within the last few days been corroborated by the repetition of the same occurrence in a loaf which my servant purchased at a baker’s residing within 100 yards of my house. That loaf presented at one of its edges a remarkably shining appearance, due to an agglomeration of very fine glistening crystals, which I identified as alum. On submitting 1,500 grains of that loaf to analysis I obtained

an amount of alumina and of sulphuric acid representing 23·9 grains of alum! Whence did that alum come? Admitting that the mixing of that substance with flour took place at the mill, is it then a fact that such miserable evasion of the law can shelter the delinquent baker, who subsequently uses the adulterated flour? If flour or the bread is found on the baker's premises to contain alum, the drug may surely be legally considered as being on the premises. It is true that the alum is then in a mixed state, but the act does not say anything regarding the state in which it may be; it declares only (section 6) "that the use of alum or of any other unwholesome ingredient in flour is a punishable offence, and that any such ingredient or mixture is to be forfeited." I am not a lawyer, and therefore cannot form an accurate opinion of the meaning of the act legally considered, but it appears to me that, if the law be susceptible of such an extraordinary interpretation—namely, that the baker does not come within the class of offenders provided against—it is clear that millers, by simply mixing the alum with the corn to be ground before it enters their mills, may, with impunity, proceed to grind the mixture, and thus defy petty sessions and police superintendents, magistrates, the public, and the act of parliament.

Howbeit, and in spite of all legislative measures, and of whatever certain persons, from various motives, may say to the contrary, this is certain—namely, that all articles of food in general are most frequently met with in an adulterated state; that genuine bread, in particular, is hardly ever to be found; that the remedies hitherto provided are quite insufficient to arrest, or even to diminish the evil. Any one who could have seen the almost overwhelming number of letters and of samples of all manner of goods which were forwarded to me during the fortnight that followed my evidence before the committee, and the earnest request made by my correspondents to test and analyse their articles, and give them my report thereon, would have thought that the trade had really been maligned, or that if the adulterations denounced before Parliament were considerable, the number of dealers supplying the public with first-rate and pure articles was considerable also; but, knowing what an unfair and dishonest use has frequently been made by some tradesmen of scientific reports—knowing how frequently spurious goods have been sold, and still continue to be sold, under the apparent sanction of certificates given (I have no doubt) from analyses of genuine samples supplied for the sole purpose of obtaining such documents—I have hit upon the following plan, which, I think, is calculated to do some good. To all those, therefore, who had favored me with samples for analyses, and had requested me to send a report, I wrote that, for the reason which I have just stated, I had resolved not to grant certificates for publication, however genuine the article supplied might be, unless the person in whose behalf such a certificate was written undertook to pay 50 guineas to a charitable institution should the article so reported upon be at any time afterwards offered for sale in an adulterated state at his establishment. I am sorry now to add that, of all my correspondents who so boasted of selling or manu-

facturing nothing but genuine goods, only two have accepted the stipulated conditions, and I beg to give their names here, which you are at liberty to publish or not as your own discretion may dictate. They are Messrs. Dunn and Hewett, chocolate manufacturers, of 9, King's Row, Pentonville, a firm, I believe, with a very large business; the other is a small baker named W. Weston, of 25, Aldenham Terrace, Old Pancras Road. He sells bread of the first and second quality, both made of genuine flour, and both delicious.

In conclusion, I have now to apologise for troubling you with this long letter, but I thought that you would, perhaps, lend again your most powerful aid in giving publicity to the above facts, and to a plan which, if acted upon by other chemists, may give additional value to their reports, test the genuineness of the pretensions of all dealers or manufacturers, and act as a remedy against adulteration, if the public will only take the trouble of supporting only those who, being provided with certificates obtained under such conditions, offer a better guarantee of fair dealing than could be secured by any legislative enactment.

I remain, Sir, your most obedient servant,

A. NORMANDY.

67, Judd Street, Brunswick Square, Nov. 2.

—*Times*, Nov. 5, 1855.

PHYSIOLOGICAL & PATHOLOGICAL CHEMISTRY.

MEMOIR on the COMPOSITION of HÆMATOIDINE.

By M. C. ROBIN.

THE object of this Memoir is to bring within the domain of chemistry a compound which is formed, in the animal economy, at the expence of the coloring matter of the blood. It has long been known to physicians from the distinctness of its crystalline forms and the beauty of its red color, because they have been able to observe the conditions in which it is produced; but it has been neglected by chemists, because it had hitherto been obtained only in small quantity.

Thanks to the kindness of M. Mercier I have been able to procure a mass weighing 3 grammes, entirely formed of very regular crystals, which were agglomerated in a hydatid cyst of the liver. The body of which I speak has received the name of *hæmatoidine*. It is known that the red coloring matter of the globules of the blood received, in 1827, from M. Chevreul, the name of *hæmatosine*, and that many authors have since called it *hæmatine*; but erroneously, for so far back as 1811, M. Chevreul gave the name of *hæmatine* to the yellow red coloring matter, Campeachy wood (*Hæmatoxylon Campechianum*.) L.

Hæmatosine is not crystallisable; but almost every time that the blood has effused into the thickness of the tissues of a living animal, we perceive, from four to twenty days after the hemorrhage, the formation of very clear microscopical crystals, sometimes in the form of needles; however, most of them were oblique prisms with a rhombic base and of a fine red. It is these crystals which, figured and described

successively by Sir Everard Horne in 1830, by Rokitauský in 1842, by Scherer in 1843, by Zwicky in 1846, were designated in 1847, by Verchon, by the name of hæmatoidine. Chemical analysis will soon show us that the *crystallisable hæmatoidine* is *uncrystallisable hæmatosine* which has lost all its iron, but has acquired 1 equivalent of water.

The oblique prisms with a rhomboïdal base, like the needles of hæmatoidine are very hard, and brittle, and strongly refract the light under the microscope; they have a bright orange red, or scarlet, towards the centre, and of a deep carmine red on the edges and extremities. By reflected light, separated from all impurity, they are of the fine red color of biniodide of mercury or alizarino. These crystals have a very intense coloring power; they are rather heavier than water; but form in uniting with it a voluminous mass. The value of the angles is from 118 and 62°.

Heated in contact with the air, it gives at first an odor of tar, then of burning horn or nitrogenous matter; it then inflames, turns like a taper, and gives a bulky carbonaceous residue, which is swelled up, and finally disappears completely; however the compound is difficult to burn in the combustion apparatus. Out of contact with the air, heat disengages from it putrid gases, a substance having the appearance of tar, and it leaves a bulky, swelled up, carbonaceous residue.

Water, alcohol, ether, glycerine, the essential oils and acetic acid, do not dissolve a trace of this compound; ammonia rapidly dissolves it with an amaranth red tint when the solution is concentrated, and, in all cases, the latter very soon passes to saffron yellow, and then brownish. Potassa and soda swell up the crystals of hæmatoidine, furrow them and gradually dissolve them, but in very small proportion compared with ammonia; the solution is reddish. Nitric acid dissolves this body very quickly; the solution is of a very deep red, and bubbles of gas are disengaged when it is concentrated. Hydrochloric acid dissolves it, but sparingly; the solution is of a golden yellow or reddish yellow color; the crystals remaining have an ochrey tint by reflected light, and reddish yellow under the microscope. Sulphuric acid does not dissolve it; it only renders the color deeper and deeper, and, moreover, it acquires a green tint when traces of ferruginous and alkaline compounds still accompany the crystals.

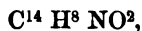
After having ascertained by the microscope that washing with water, alcohol and ether, had left only crystals without any impurities, and that it was a perfectly crystallised product, I obtained with the assistance of M. Riche the following results:—

Hæmatoidine.	I.	II.	III.	Hæmatosine; mean of 5 analyses by Malden.
Carbon .	65·0460	65·8510	„	65·84 or C ⁴⁴
Hydrogen .	6·3700	6·4650	„	5·37 „ H ²²
Nitrogen .	„	„	10·5050	10·40 „ N ⁸
Oxygen .	18·0888	17·1788	„	11·75 „ O ⁶
Ashes .	00·0002	00·0002	Iron	6·64 „ Fe.

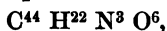
Two combustions made with the special object of determining the

quantity of iron which the hæmatoïdine might contain, were operated, one with 34 centigrammes, the other with 55 centigrammes of this compound; they furnished, the first, seven-tenths of a milligramme, and the second, one milligramme and three-tenths, of a whitish grey residue, of an ashy aspect, but not resembling oxide of iron. This residue did not contain lime, but traces of alkaline salts and a considerable quantity of iron, detected by means of prussiate of potash. It is easy to see that these are the remains of impurities fixed in the crystals, and which the washings have not been able to remove, as often happens with compounds of organic origin. This residue, if it had been composed only of oxide of iron, would be manifestly too small for us to imagine as anything but an impurity with relation to hæmatoïdine, and to include it in its formula. I found neither sulphur nor phosphorus.

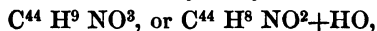
In comparing the numbers furnished by my analyses, we are struck with their agreement with those obtained in 1839, by Mulder, who evidently operated on pure hæmatosine. If we remove the iron from *uncrystallisable hæmatosine* by digestion in concentrated sulphuric acid, or by means of chlorine, as Mulder did, there remains a body composed of 70.49 of carbon, 5.76 of hydrogen, 11.16 of nitrogen, and 12.59 of oxygen, that is to say, a body having the composition given above for hæmatosine, minus the iron. The formula which these numbers give for this product is



or, as Mulder writes, by comparison with that of hæmatosine,



now, as that which results from my analyses of *hæmatoïdine* is,



it will readily be perceived that hæmatoïdine is not the coloring matter of the blood or hæmatosine, but a chemical compound which arises from its decomposition, in which 1 equivalent of water (HO) has replaced 1 equivalent of iron (Fe).

The quantity of hæmatoïdine extracted from the hydrated cyst of the liver corresponds to at least 1800 grammes of blood, which must successively have effused through it in order to give rise to its formation.

Comptes Rendus, No. 14, Oct. 1, 1855.

CHEMICAL EXAMINATION of the SUBSTANCE of which WENS are COMPOSED.

By J. L. LASSAIGNE.

WE generally know by the name of wens encysted tumors, situated under the skin, circumscribed, moveable, and capable of attaining to a considerable size. These tumors, according to the nature of the matters which they contain, bear in pathology, various names.

In a work undertaken in 1852, by Dr. Legrand, that physician having furnished us with numerous opportunities of chemically examining several of these tumors, which he had extracted by a process of his own invention, we were enabled to make a comparative examination and to transmit to him the results, which he included in his work.

The nature of these tumors being still little known, as well as the relation of the proximate principles found in them by chemical analysis, we have thought that it would not be uninteresting to physicians and chemists to publish here the composition of two of these tumors, one of which was situated on the shoulder, and the other on the occiput of two persons treated by Dr. Legrand.

The first of these concretions presented in its composition the union of a very large quantity of albuminoid matter with a soft, fatty matter, and a little cholesterine.

The second was almost entirely formed of this last substance, and gave to the matter contained in this tumor a very remarkable pearly and micaceous aspect.

The following were the proportions of these various principles, as shown by analysis.

Matter from the tumor situated on the shoulder:—

Yellow, soft, fatty matter, very soluble in sulphuric ether	15
Cholesterine	2
Concreted albuminoid matter, with traces of phosphate of lime	83
	100

Substance extracted from a very large wen situated on the occiput:

Moisture	55
Cholesterine	44
Concreted albuminoid matter	1
	100

Journal de Chimie Medicale, Sept., 1855.

On the MECHANISM of the FORMATION of SUGAR in the LIVER.

By M. CLAUDE BERNARD.

(Concluded from page 116.)

ALL the secretions necessarily require two things for their accomplishment: 1st. blood; 2nd. a glandular tissue. We shall endeavor to appreciate the part played respectively by each of these elements in the production of sugar.

In 1849, M. Schmidt, of Dorpat,* unacquainted with my work on the glucogenic function of the liver, insisted on the idea that the sugar which exists normally in the blood of man and animals should be

*(See THE CHEMIST, New Series, Vol. ii, 1854-5, page x.)

regarded as one of the constituent principles of this fluid, and he held that this sugar is formed, like urea or carbonic acid, at all points of the circulatory system, and directly at the expence of certain principles of the blood. According to this author, the production of sugar would depend on an oxidation of the fatty matters which circulate in the blood, and he expresses his hypothesis by means of chemical formulæ which I need not insert here.

Again, M. Lehmann, of Leipzig, after having been convinced of the reality of the glucogenic function of the liver by his beautiful comparative analysis of the blood of the *vena porta* and of the blood of the hepatic veins, of which the Academy knows the results, was also led to seek the mechanism of the production of sugar in the liver. Having proved that the saccharine blood which issues from the liver by the hepatic veins, contains less fibrine and less hæmatosine than the non-saccharine blood which enters into this organ by the *vena porta*, M. Lehmann thought that this latter substance might, by being split in the liver, contribute to the formation of the sugar; and it is known that this skilful chemist has been enabled by a very ingenious process to effect the splitting of crystallised hæmatosine, which he first obtained, into sugar (glucose) and a nitrogenous matter with which it would be intimately combined. M. Lehmann is of opinion that the liver performs its glucogenic function by splitting certain albuminoid substances of the blood into sugar and into nitrogenous matters which, perhaps, take part in the formation of the nitrogenous principles of the bile.

Mr. Frerichs, of Breslau, who has likewise confirmed my experiments on the formation of sugar in the liver, at the expence of the nitrogenous aliments, admits that this organ accomplishes its glucogenic function by decomposing in a certain manner, and according to the hypothetical formulæ which he gives, nitrogenous matters which would give rise in the liver to urea and to sugar. Wagner's *Handwörterbuch der Physiologie*, iii. p. 831.

The hypotheses on the formation of sugar in the liver which I have just mentioned, express the idea which is now generally held as to the mechanism of decoctions. It is thought, indeed, that the glandular organ furnishes nothing to secretion, but that its tissue confines itself to acting by a sort of action of contact or catalytic action on the elements of the blood, which traverses the glandular organ at the very moment the secretion is performed. As to the particular case of the secretion of the sugar in the liver, we have seen, indeed, that all the authors suppose that the saccharine matter is formed *directly* in the blood.

The facts which I have published up to this time, appear to me of a nature to prove that we must understand quite otherwise the glucogenic function of the liver, and that, instead of seeking in the blood the substance which precede the sugar and immediately gives rise to it, it must be sought in the hepatic tissue itself.

The following is an experiment that I have made, and which will elucidate this fact; I shall describe it somewhat in detail in order that

its results, which appear to me very important and highly interesting to both physiologists and chemists, may easily be reproduced.

I selected an adult, vigorous and healthy dog, which was fed for several days exclusively with meat, and I killed it by a section of the *rachidin bulb*, seven hours after a plentiful meal of tripe. As soon as the abdomen was opened, the liver was removed, care being taken to avoid wounding its tissues, and this organ while still warm and before the blood had time to coagulate in its vessels, was washed with cold water by the *vena porta*. For that purpose I took a tube of gutta percha, about a yard in length, and having at its two extremities an adjustment of copper. The tube being previously filled with water, one of its extremities was firmly fixed on the trunk of the *vena porta* at its entry into the liver, and the other was adjusted to the stop-cock of the laboratory fountain of the College of France. On opening the stop-cock, the water traversed the liver with great rapidity, for the force of the current of water was capable, as had been determined, of raising a column of mercury 127 centimetres (about 50 inches) in height. Under the influence of this energetic washing, the liver swelled up, its tissues became pale, and the blood was expelled with the water in a powerful and continuous jet by the hepatic veins. In a quarter of an hour, the tissue of the liver was almost exhausted of blood, and the water which issued from the hepatic veins was entirely colorless. I left this liver subjected to this continued washing for about forty minutes without interruption. I proved at the commencement of the experiment, that the colored water which issued from the hepatic veins was saccharine, and precipitated abundantly by heat, and I found at the end of the experiment that the perfectly colorless water which issued from these same veins no longer contained any trace of albuminous matter or sugar.

This liver was removed from the action of the current of water, and I ascertained by boiling a portion of it with a little water, that its tissue was well washed, since it no longer contained any saccharine matter. Its decoction gave no sign of reducing the cuprotartrate of potassa nor any trace of fermentation with beer yeast. There escaped from the cutting of the hepatic tissue and from the opened vessels a small quantity of a turbid liquid, which did not contain a trace of saccharine matter. I then left this liver in a vessel at the ordinary temperature, and on returning twenty-four hours after, I found that this organ, which I had left the day before completely deprived of sugar, now contained it in great abundance. It was sufficient, in order to convince myself of it, to examine a little of the liquid, which had flowed out around the liver, and which was strongly saccharine; afterwards, by injecting by means of a small syringe with cold water by the *vena porta*, and collecting this water when it issued by the hepatic veins, I proved that this liquid gave rise with beer yeast, to a very abundant and very active fermentation.

This very simple experiment, in which we see saccharine matter in abundance in a liver which had been completely freed from it as well as its blood, by means of washing, is one of the most instructive as

regards the solution of the question of the glucogenic function of the liver with which we are occupied. This experiment proves clearly, as we have advanced, that in a fresh liver in the physiological state, that is to say, in function, there are two substances, namely:—1. Sugar very soluble in water, which is carried away with the blood by washing: 2. Another matter so sparingly soluble in water as to remain fixed in the hepatic tissue after the latter has been deprived of its sugar by washing for forty minutes. It is this latter substance which, in the liver abandoned to itself, was gradually changed into sugar by a sort of fermentation, as we have just shown.

Indeed, this new formation of sugar in the washed liver is completely prevented by cooking. If we cook, for example, half of a liver immediately after the washing, we ascertain that at the very moment of its decoction, it is generally opalescent, contains no sugar, and that it does not contain any next day, which is a proof that none is developed. We prove, on the contrary, in the other half of the liver which has not been cooked, that the saccharine matter is produced in a few hours, and that its quantity goes on gradually increasing to such a degree as to amount, sometimes, in twenty-four hours, to equal proportions of sugar to those originally contained in the liver.

This formation of glucose is generally terminated after twenty-four hours, and if after this time the liver be again submitted to washing by a current of water, so as to remove all the newly-formed sugar, we generally find that no more is produced, because the matter which formed it is doubtless exhausted. There is now dissolved only a kind of albuminous matter which always accompanies the production of sugar, although it appears completely independant of it, as I shall say further on. Finally, this formation of glucose has generally appeared to me more rapid when the contact of the air has been multiplied by cutting the liver into pieces and at the same time moistening with water.

We have already stated above that the hepatic matter which is susceptible of being changed into sugar must be almost insoluble in water. This matter is likewise insoluble in alcohol, as the following experiment proves:—

I took the liver of an animal during the act of digestion; I bruised its tissue while quite warm; or, better still, after having washed it a little by means of a syringe with ordinary alcohol by the *vena porta*, in order to free the hepatic tissue from a portion of its blood. Afterwards, I separated the vessels and nerves from the liver, pressing its tissue on a very fine hair sieve, so as to collect only the pulp of the organ which passed through the sieve. This species of hepatic pulp was afterwards agitated, macerated, and washed several times with cold alcohol, in order to completely exhaust it of the sugar which it might contain, and to retain only the substances insoluble in alcohol. This hepatic pulp was afterwards collected on a filter and placed on blotting paper, in an oven, whose temperature did not exceed 40° C. (104° F.), and in which the dessiccation was accelerated by a current of air. I took care to divide the matter, so that the dessiccation might

take place regularly. I thus obtained a pulverulent substance, formed of the glandular part of the liver which was well dried and freed from sugar, but which retained with it the hepatic matter in question, susceptible of giving rise to sugar as soon as it was replaced in water. Indeed, when I moistened this hepatic powder with ordinary water, afterwards leaving the whole to the temperature of the atmosphere, I found after a few hours that the water contained very considerable proportions of sugar. It could not be objected that the sugar which was then manifested had been retained in the hepatic tissue, because alcohol is not so good a solvent as water; for when I added the hepatic powder to water kept boiling for a few minutes, I did not remark any appearance of saccharine matter, which moreover perfectly agrees with what we have already said of this matter, whose glucosic reaction in the liver washed with water was likewise prevented by cooking.

Ether does not appear to alter the singular matter with which we are occupied, for I allowed the hepatic pulp, previously treated with alcohol and dried, to macerate for several hours, and I found that this pulp still retained the power of forming sugar.

I will confine myself to these experiments for the present. The matter of which I have here only in some measure indicated the existence, must be isolated and studied further with care in a chemical and physiological point of view. I will only add, in this latter regard, that I have found that this matter exists in the liver only in the normal or functional state and that it disappears completely from the tissue of this organ in all the circumstances in which the glucogenic function is arrested, which circumstances I have long since established. This matter belongs exclusively to the tissue of the liver in which it takes rise, for I have very often proved that there is no traces of it in the blood of the *vena porta* nor in the blood of other parts of the body.

Finally, I may remark that during life this matter, being incessantly renewed in the hepatic tissue under the influence of nutrition, is continually converted in it into saccharine matter, which replaces in the liver the sugar which the current of blood perpetually carries away by the hepatic veins. After death, in a liver extracted from the body, this matter, under the influence of moisture, may continue to be converted into sugar until it is exhausted. But as then no more sugar leaves the liver by the circulation, it results that then the saccharine matter accumulates and that its proportion augments in the hepatic tissue after death. Thus the tissue of the liver is always more saccharine the day after the animal is killed than on that on which it is killed, and sometimes this difference is in considerable proportion. All the estimations which have been made of the sugar in the liver must therefore be repeated after the knowledge of these new facts.

To sum up, the only object of my work for the moment, is to prove that the sugar which is formed in the liver is not produced at once in the blood, but that its presence is constantly preceded by a special matter deposited in the tissue of the liver, and which immediately gives rise to it. I have decided on publishing this still unfinished work, because it has appeared to me useful, for the solution of the

glucogenic question with which we are occupied, to draw the attention of chemists to phenomena which are not known to them, and which appear to me of a nature to change the point of view in which we now stand in order to comprehend chemically the production of sugar in the liver. Indeed, it is now no longer necessary to construct hypotheses as to the source of the sugar in the liver nor as to the possibility of the direct and immediate separation of such and such an element of the blood in order to produce this sugar. We must endeavor to isolate this singular hepatic matter which pre-exists, to ascertain how it is secreted in the liver, and how afterwards it undergoes the successive transformations which change it into sugar. There is probably between these two extremes—the insoluble matter as it is secreted by the vital action of the liver and the sugar which emanates from it and issues from the organ with the blood of the hepatic veins—a series of intermediate formations which I have not seen, but which chemists will doubtless discover.

Comptes Rendus, No. 15, Sept., 24, 1855.

PHOTOGRAPHY.

On the CAUSES which lead to the ALTERATION of POSITIVE PHOTOGRAPHIC PROOFS, and on a MEANS of REVIVING them.

By MM. DAVANNE and GIRARD.

IF there is anything which still impedes the great development which photography is calculated to take, it is certainly the instability which positive proofs generally present; there are few, indeed, which are capable of resisting a few years contact with atmospheric agents: we intend here to speak only of proofs prepared by the ordinary process of the hyposulphite, and not of these in which the salts of gold are employed.

It is known that the first of these processes which alone has hitherto enjoyed the favor of photographers, consists first of steeping the proof, on leaving the reproduction frame, in a bath of hyposulphite of soda, in order to dissolve the undecomposed chloride of silver: on leaving this bath it has a red-fawn tint which we seek to replace by beautiful violet black tints, which are obtained in the tinting baths. These are composed of hyposulphite of soda to which acetic acid or chloride of silver has been added. On leaving these baths, the proof is covered with beautiful tints, but experience has long since shown that these do not present any solidity.

Hitherto various hypotheses had been started as to this fact of destruction, without any serious study having ever been undertaken; we have sought to fill up this vacuum and to elucidate this interesting subject by chemical analysis. In reflecting on the foregoing operations, everything led us to presume that a red proof, fixed and not tinted, was formed of finely divided metallic silver, and not of subchloride of silver, as commonly supposed: that this silver, in contact with the above

mentioned baths, was converted into a sulphuret which the atmospheric emanations instantly modified. The correctness of this hypothesis was shown by experiment.

To verify it analytically, we sought—1. What was the state of the silver on a positive sheet fixed and not tinted, seeking incidentally if any hyposulphite of soda remained in the pulp of the paper. 2. What was the state of the silver on a positive proof tinted by the usual processes, that is to say, by means of hyposulphites charged with chloride of silver or acetic acid, of those baths which photographers call old hyposulphites.

The process which we employed for effecting the analysis was very simple; it consisted in impregnating the sheet of paper with a solution of nitrate of potassa and carbonate of soda, in burning it and analysing the ashes: after calcination, the silver remained in the insoluble state, whilst the chlorine and the sulphur were converted into chlorides and sulphates. We first verified the accuracy of this process by burning a sheet impregnated with chloride of silver, estimating, in the ashes, the silver by chlorine and the chlorine by silver, and weighing the two precipitates of chloride, which are found to be identical; we likewise determined by this means the composition of the ashes of the photographic paper, so as to be able to take account of it in the subsequent analyses.

In order to decide the first question, we completely blackened in the light a sheet impregnated with chloride of silver; we afterwards washed it with new hyposulphite of soda, then with distilled water, and we finally burned it. We found in the ashes no traces of sulphates; the quantity of chlorine amounted to 0.002 gr.; that of silver to 0.124 gr. It was therefore at once evident that the new hyposulphite of soda had left no trace of sulphur; besides, the proportion of chlorine was so small in presence of that of the silver, that it might be regarded as an impurity of the paper; the formula Ag^2Cl would have required ten times as much, or 0.020. Being several times repeated, this analysis gave us uniformly the same result; but, before drawing any conclusion from it, we wished to give it a more palpable form. We prepared a relatively large quantity of chloride of silver, we spread it out in a capsule, agitated for a day in the solar light, washed it with the hyposulphite, and then with distilled water; the residue fused with pure carbonate of soda gave a button of metallic silver; but the flux did not contain a trace of chlorine. We may add, moreover, that the surface of the photographic processes is perfectly soluble in nitric acid, whilst the subchloride is considered insoluble.

From these experiments, we think we may conclude that the positive photographic image is formed of metallic silver, and not of subchloride of silver, as has hitherto been supposed.

In order to determine what was the state of the silver in the tinted proofs, we analysed a certain number of them, on which we had produced the violet tints desired, by means of the ordinary tinting baths (hyposulphite of soda mixed with acetic acid or a salt of silver), and we always found in it not only silver, but also sulphur, these two

bodies being met with in nearly atomic quantities, such as the formula Ag_2S requires. This result is constantly reproduced, and we concluded from it that, in the above mentioned tinting baths, the silver with which the sheet is covered is converted into sulphuret: a reaction which it is easy to comprehend when we remember that the hyposulphites are immediately decomposed by acetic acid, and when we know, as experience has shown us, that these salts mixed with a solution of nitrate of silver almost instantly convert the latter into sulphuret.

Passing next to the study of the altered proofs, we submitted to analysis proofs prepared several years ago, and whose black tints were converted into yellow ones, proofs which we had ourselves passed through, abandoning them for several days in water after the tinting; and, finally, others which we sulphurised directly; in all, we had found sulphur and silver, and, which is a curious thing, the proportions were sensibly the same as in the black proofs as they came out of the tinting baths.

It was thus established that in the fixed proofs analysis detected only sulphur, whilst in those which had been tinted, which were black or yellow, there was sulphur and silver, and these two bodies only. It remained to be known whether the sulphuration was really the cause of the destruction of the images. In order to ascertain this, we sulphurised well fixed proofs, either by photographic processes, or in hydrosulphuric baths, or in a current of sulphuretted hydrogen, and every time these sulphurised proofs came by any means in contact with moisture, their black tints rapidly disappeared, giving place to yellow tints, whilst the proofs simply fixed suffered no alteration. We will not relate all the trials which we undertook; two will suffice: in the first a sheet was abandoned for a long time in a solution of hydrosulphuric acid; it ran rapidly through the ordinary tints, and maintained, finally, in the liquid itself, the yellow tint of the proofs passed through; in the second, a proof previously dried in an oven, then kept for twenty-four hours in a perfectly dry current of sulphuretted hydrogen, retained its black tints, but rapidly turned yellow, when we afterwards put it in contact with water.

Reasoning by analogy, we think we may say that in the ordinary photographic processes, the sulphuration causes the tinting, and in the presence of moisture induces destruction. The employment of the salts of gold, giving rise to variations of quite another order, has not these inconveniences.

It would remain to be ascertained why this black sulphuret of silver becomes yellow in the presence of humidity. As there is in the two cases no change in the proportion of the constituent elements, we are forced to admit either a hydratation of the compound, or an isomeric modification analogous to that of the red and black sulphurets of mercury.

In conclusion, we may say that it is easy, when a proof thus prepared has been destroyed by time, to restore to it black tones the intensity of which may be increased or diminished at will; it is sufficient for that purpose to immerse it for some hours, and in the dark, in a bath

containing per litre two or three grammes of chloride of gold : a double decomposition is operated, and gold is deposited in the place of the silver ; the chloride of silver formed is afterwards removed by means of a weak solution of hyposulphite of soda, and washed, and the proof is thus found to be perfectly revived.

Comptes Rendus, No. 17, Oct. 22, 1855.

*On HELIOGRAPHIC ENGRAVING obtained directly in the CAMERA ;
and on some SCIENTIFIC EXPERIMENTS.*

By M. NIEPCE DE SAINT VICTOR.

To complete the processes of heliographic engraving, it was required that we should obtain the proof on the steel plate, directly, in the camera, a result which has not hitherto been obtained, except in conditions which would not permit the plate to be eaten.

I have at length succeeded in this object and I have now the honor of presenting to the Academy proofs, taken from a steel plate on which the heliographic drawing was obtained, directly, in the camera, without re-touching, for I made all these experiments myself, and I am not an engraver.

In operations by contact, that is, when a black design is applied to a steel plate rendered sensitive by the bitumen operation, which I have described in former Memoirs, a perfectly discovered image is obtained on the plate, that is, when the metal is almost entirely uncovered in the parts which correspond to the deepest shadows ; at least the image ought to appear thus if properly attacked.

But when operating in the camera obscura we must not endeavor to obtain an image resembling that produced by contact, that is to say, similar to the daguerrean image, because in this case it would be necessary to use a freshly prepared varnish, not rendered sensitive, (as I shall show further on), which would necessitate a very long exposure to the light.

I therefore endeavored to find a varnish which would produce an image in the camera obscura in the least possible time and well corroded, and I have only obtained this result by using a varnish which had been rendered very sensitive by exposure to air and light ; but then this varnish only produces images which are indistinct and veiled, as I have described them in my last Memoir, but they are necessarily so when we operate in the camera obscura.

Any Judea bitumen can be rendered fit for heliographic engraving in the camera obscura, remembering always that the best of these exceptional products will be those which are naturally sensitive, for they give, in a short time, more distinct images than those obtained with a varnish which is rendered sensitive by exposure to the air and light.

The Judea bitumen being dissolved in benzine and a tenth part of essence of lemon, as I mentioned in my last Memoir, the varnish thus prepared and kept in a bottle which must not be quite full and the cork of which will admit the air, it is exposed to the solar light for

half an hour, or at most an hour, or to diffused light for five or six hours.

The time of exposure to the air and light must depend upon the natural sensitiveness of the Judea bitumen, and whether the benzine and essence have already been subjected, more or less, to the action of air and light, for these agents exercise their action so rapidly on benzine and essence of lemon, that these substances must be employed when quite freshly made, or at any rate must be preserved from the action of the light; they may, without injury be exposed to the influence of air alone, which I will explain in the second part of this Memoir.

The sensitiveness of the varnish must be studied, and to ascertain its qualities I would advise some experiments by contact; if we obtain a good proof in three or four minutes in the sun (with a photographic proof on albumenised glass) unveiled, the varnish is then sufficiently sensitive to act in the camera obscura.

The time of exposure of the varnished plate placed in the camera obscura, varies from half an hour to three hours in the sun, and from two to six in diffused light. The varnish may be rendered much more sensitive by longer exposure to the air and light; but the more sensitive the varnish, the less distinct will the image be when acted on by the solvent, and when the exposure of the varnish to the air and light has been too prolonged, it becomes quite inert; to avoid this inconvenience it is necessary to prepare only a small quantity at a time, because, when once the varnish has been subjected to the influence of the air and light it acquires sensitiveness even if hermetically sealed and kept in the dark, which makes me think that when once the varnish has undergone the influence of air and light, the action continues, even when it is removed from their immediate presence.

I have now to speak of the resistance of the varnish to the action of aqua-fortis; in operations by contact it generally offers more resistance than when we operate in the camera obscura. I have endeavored to consolidate the varnish of the latter image.

After numerous experiments on the essences which might be mixed with benzine to obtain a greater impermeability, I have never found anything succeed better than essence of lemon; but it does not always give sufficient resistance, and the first necessary condition is, that the varnish which has received the proof in the camera obscura, and which remained adherent to the plate after the action of the solvent, should present the same aspect as before its exposure to the light, namely, a brilliant and iridescent aspect, and the image must not be too much veiled.

When the varnish is in this state, we may, especially when it has remained for several days exposed to a current of air, corrode the plate; but it is better to use the vapors of essence of spikenard, mentioned in my last Memoir under the name of *fumigations*, which I have not hitherto been able to replace with advantage; it is however necessary to be cautious in their application.

I have suppressed the appearance of *aqua tinta* in the proofs obtained

directly in the camera obscura, which has been objected to in the reproduction of photographs obtained by contact on a steel plate.

Sometimes aqua-fortis alone will attack the plate sufficiently (especially with small, very fine images) to enable us to ink it and take good impressions; but it sometimes occurs that by too prolonged an action the delicacy of the image is destroyed, and the finest lines become rough.

It is therefore preferable, especially in large pictures, not to press the corrosion so far, and to give what I term the *chemical finish*, which I obtain by means of iodised water, which in this case slightly softens the marks made by the aqua-fortis. We may then ink a plate which has not been eaten into very deeply, and the design will have retained all its delicacy, if we have taken the precaution of not prolonging too much the action of the iodised water.

When we no longer apply the *aqua tinta* finish to the resin and consequently do not heat the plate, we can, if we wish, use a caoutchouc varnish which I described in my last Memoir on heliographic engraving on glass (See THE CHEMIST, vol. ii.); but I prefer fumigation and the varnish which I have described before, because this varnish, being more homogeneous, gives purer results.

The benzine must be dried if we wish for a smooth coat of varnish; as for the details of the manipulation I intend to give them in a Manual of heliographic engraving in which I shall give an abstract of all that I have published on this subject.

By means of the operations which I have described, we obtain directly in the camera obscura, on a steel plate, an engraved photographic image, from which may be taken, by the same means as copper plate printing, copies which, from the delicacy of their effects, will rival photographic proofs on paper. They are, moreover, unalterable, so as to give a great many copies, which may therefore be sold at a very moderate price.

I have now only to render the varnish more sensitive without loss of its good qualities, so as to shorten the time of exposure in the camera obscura; I shall continue my investigations until I am successful, as well as in the application of this to the reproduction of oil-paintings. The aim of all my endeavors is to conclude the work begun by my uncle Nicéphore Niepce; I shall indeed be happy should I attain this desirable result.

Action of different gases on a plate covered with a heliographic varnish composed of Judea bitumen.

As was foreseen by M. Chevreul, my experiments have proved that the heliographic varnish undergoes no alteration in a luminous vacuum, I wished to ascertain which gas was the most active of those which enter into the composition of atmospheric air.

A priori we might have thought that it was the oxygen of the air which acted on the heliographic varnish, by producing an oxidation, as on many other bodies.

I can now state positively that it is the oxygen which acts; for from numerous experiments which I have made at the Gobelins under the eye of M. Chevreul, it results that oxygen has always acted more efficaciously than the air itself, at the same time that the results of its action differed but little from those obtained from the open air.

Hydrogen produced no effect; pure nitrogen produced none either: so that it is very evident that oxygen is indispensable for the production of photographic phenomena upon organic substances.

If, on the contrary, we act upon inorganic matters, such as the salts of silver used in photography, atmospheric air has no share in the operation, for the compounds of silver become black in the luminous vacuum. I have been unable to ascertain much difference; if there be any, it is in favor of the vacuum.

Such are the results obtained by the frequent repetition of the same experiment, and when operating with every advantage; in these I have been much assisted by M. Decaux, preparator to M. Chevreul at the Gobelins.

Observations on the different action of air and light on benzine and the essences.

In the first part of this Memoir I mentioned the action which light and air produced upon the heliographic varnish in the liquid state; I shall now give the result of some observations on this subject.

Atmospheric air alone acts on benzine in a different manner from air and light together, whence it results that benzine may be strongly colored by the influence of the air alone, if distillation has not completely removed from it all the resinous and bituminous matters which it contained; but it does not become oxygenous or oxidised except under the influence of both air and light.

If the benzine has been distilled several times and is thus quite freed from the foreign matters contained in it, it will no longer become colored under the influence of the air, even when united to the action of light; it will not oxidise except after very prolonged exposure, and then only very slightly; it may be said to be almost inert.

Benzine in this state may be used to form a heliographic varnish, but the varnish will then require a much larger exposure to the air and light, because its sensitiveness will depend entirely on the Judea bitumen and essence.

Essences behave like benzine; only there is a greater variation in the time necessary for air and light united to affect them. There is a difference not only between the various species but even between the specimens of each species.

These observations are the results of my experiments, and I thought myself bound to communicate them to the Academy as being very interesting in a scientific point of view.

Comptes Rendus, No. 15, Oct. 8, 1855.

ON TWO PHOTOGRAPHIC PROCESSES.

By M. TAUPENOT.

THIS communication comprises two processes.

The first is a means of giving to collodion negatives on glass a solidity which has not been attained without varnish. Now, as this plan has some drawbacks, M. Taupenot proposes to substitute another.

The second process is for the preparation of photographs *on dry albumenised collodion*. This plate, in the dry state, retains its sensibility for several days, and is therefore valuable in exploring tours, and in all cases in which we wish to secure fugitive effects.

M. Taupenot, with a disinterestedness which does him honor, gives these processes to the public, and describes them as follows:—

First Process.—Collodion clichés require varnishing, to render them capable of resisting the action of taking positive proofs from them. The various varnishes hitherto used have the drawback of being more or less expensive, require skill in using them, and some precautions, and, finally, frequently become spoilt, so that the pictures on them are injured. M. Taupenot replaces them by a very cheap substance, easily used, which is always at hand, and which gives great solidity to clichés, without in any way injuring their transparency nor the purity of their lines. This substance is albumen.

It may be used fresh or fermented with a little honey. In this latter state it may be preserved for an indefinite period, and filtered as easily as water, so that it can at any time be had perfectly free from dust when it is wanted. Whether fresh or stale, this albumen is used in the following manner:—

On the collodion cliché, finished and washed, is poured a small quantity of albumen, containing one per cent. of iodide of potassium: this is allowed to run off and dry by resting the plate in an oblique position. The plate is then immersed in the ordinary aceto-nitrate of silver bath, immediately washed and plunged into the hyposulphite bath used to fix negatives; it is again washed, and the operation is finished.

Pure albumen may be used and coagulated simply with acetic acid, but it is less adherent; it may blister, and the operation is not more simple than that previously described.

When clichés thus varnished have been stained in copying, they may be restored completely by a prolonged bath of concentrated hyposulphite, which dissolves the stains without injuring the negative protected by this thin superposed film of albumen.

Second Process.—The idea of the albumen varnish led M. Taupenot to a new process of photography on dry albumenised collodion, which has the great advantage over all the known processes of giving plates which preserve their sensitiveness for a whole day or more, so that they can be prepared over night for the next day, and that they can be taken out without the disagreeable necessity of a tent, small cisterns, phials, etc.

Moreover, the manipulations of this process are not at all complicated; the plates are more quickly and more easily prepared than those of albumen alone and dry papers.

The following is the method of operating :—

On a collodionised plate, passed through the silver bath and washed with distilled water, is poured a little albumen, containing one per cent. of iodide of potassium; it is suffered to drain and dry in darkness. As many plates can be prepared as we like. They will keep good for at least four or five days. When wanted for use, they are passed through the ordinary aceto-nitrate bath, containing ten per cent. of acetic acid and ten per cent. of nitrate of silver. They are left from ten to twenty seconds in this bath; they are washed in distilled water, and used either at once, while wet, or dry on the day of their preparation, or even on the next day, their sensitiveness remains unchanged.* When they have been exposed, they may, if it is desired, be left until the next day before the image is developed. Either gallic or pyrogallic acid may be used. The first† develops the image slowly, gives rather stronger contrasts, and stains less. Pyrogallic acid may be used in various proportions, with or without the addition of three per cent. of nitrate of silver. If used mixed with nitrate of silver, a few minutes suffice to develop the image; but stains are to be feared, and the bath of aceto-nitrate, which gives their final sensitiveness to plates, must be carefully filtered at the moment that it is to be used.

All the pictures of the Imperial Military Prytanée were thus made, with dry plates, some of which had been prepared two days before; and, nevertheless, they did not require exposure for more than a minute, and even the groups, such as the *Procession*, the *Gymnasium*, the *Players at Bowls*, and the *Review*, required only some seconds, with a French objective, provided with a diaphragm of 25 millimetres.

Conclusions.—Albumen will advantageously replace varnish, in giving to collodion negatives the solidity necessary to enable them to bear the making of positive proofs.

When superposed upon any collodion, albumen will cause it to retain its sensitiveness for a day or two, which forms a new process in photography on dry albumenised collodion, which will be found useful in a tour, as one could have plates always ready to take any view, plant, costume or peculiarity of manners which might strike us. The convenience of having sensitive plates in any number, of which one might use fifty in an hour if required, would enable us to reproduce all the chief points of great military manœuvres, even in a battle, which would be a most valuable application of photography, giving results of great utility to history, and which could not be produced by any process which has been known hitherto.

* In all his experiments M. Taupenot has always found this sensitiveness, even when prepared the day before, equal to that of the collodion used in preparing the plate, when used alone in the ordinary manner.

† Saturated, and with the addition of a drop or two of new aceto-nitrate.

M. Chevreul proposed the thanks of the Academy to M. Taupenot, and placed on the table the above-mentioned pictures to enable the members to judge of them for themselves.

These conclusions were adopted.

Comptes Rendus, No. 10, Sept. 3, 1855.

On an EASY METHOD of TRANSFERRING to WAXED CLOTH, PHOTOGRAPHIC PROOFS originally obtained by the COLLODION PROCESS.

By MM. SIRE, BRUN, and CHAPELLE.

To transfer a proof readily upon cloth, the proof must be completely dry, that is to say that the transfer must not be attempted until six hours after the last washing, and the dessication should take place where there is no dust. The edges of the glass are then slightly moistened with a damp finger; a very smooth piece of waxed cloth, a little smaller than the glass, is then prepared by slightly rubbing it with a pledget of cotton, breathing on as it is rubbed. The glass is then held at one corner, and alcohol of 40 deg. Cartier poured on it; the glass is inclined different ways until quite covered with the alcohol, the excess of which is finally allowed to run off at one angle. The glass is then placed on a horizontal table, and, without stopping, the waxed cloth is taken by the two angles of one side, the opposite side is placed on the corresponding side of the glass, then the waxed cloth is lowered gently on to the glass, taking care that no bubbles of air get between the waxed cloth and the collodion. A sheet of blotting paper is then placed at the back of the cloth, and the palm of the hand is passed gently over the paper; any excess of liquid remaining between the waxed cloth and the collodion are thus removed. It is then left alone, taking care to cover the cloth with a sheet of blotting paper and a glass of the same size as that on which is the photograph. Two or three hours after this operation, the cloth may be removed, which is done by taking hold of one corner and pulling it gently off.

Comptes Rendus, No. 10, September 3, 1855.

PREPARATION of BROMIDE of AMMONIUM for PHOTOGRAPHIC PURPOSES.

By M. ENGELHART.

M. RIEGEL having proposed to prepare bromide of ammonium by means of bromine and sulphuret of ammonia, M. Engelhart adds the following observations:—

The proportions to be used are one part of bromine, two parts of hydrosulphate of ammonia prepared with liquid ammonia of 0.960 degrees density. The dry product constitutes five-sixths of the bromine employed, which accords very well with theory.

But to arrive at this result, it is necessary to observe the following precautions:—

The bromine is introduced into a flask, and four times its volume of water added : into this the hydrosulphate of ammonia, which must be freshly prepared, is poured gently, and the mixture is agitated until the bromine has disappeared, and the liquid has lost the brown color which at first characterised it.

In operating on a certain scale, the mixture heats sufficiently to melt the displaced sulphur which runs together. Under any circumstances, it is better to boil it before filtration, to volatilise the excess of sulphuret of ammonia, and to fuse the sulphur. It is then filtered and subjected to careful evaporation. The liquid soon loses its ammonia, and becomes acid ; neutrality is then restored by means of liquid ammonia, and when the solution has acquired the consistence of honey, a few more drops of ammonia are added : it is then suffered to remain at a gentle heat until quite dry.—*Neues Repertorium*.

PHARMACY.

On FER REDUIT (PULVIS FERRI.)

By M. WOHLER.

FOR the reduced iron ordinarily used in medicine, and first prepared by M. Quevenne, by treating oxide of iron with hydrogen, M. Wöhler proposes to substitute iron divided by a different process, and which would, in his opinion, have the advantage of being more practical.

Sulphate of iron crystallised and free from copper, is introduced into a cast-iron saucepan, and heated until completely dishydrated ; to this is added three times its weight of chloride of sodium : the mixture is placed in an earthen crucible, which is closed and heated until the mass is fused. After cooling, it is treated with water, which dissolves all but the oxide of iron.

When well washed, this oxide is very pure, and consists of pure black crystalline lamellæ.

In this state it is subjected to the action of hydrogen : it is put into a gun-barrel or a glass tube surrounded with clay, and so arranged that the substance is not too much pressed together ; the tube having been put into a furnace, the disengagement tube of the hydrogen apparatus is then attached, the hydrogen gas having been previously dried by means of sulphuric acid or chloride of calcium.

The sulphuric acid used to disengage the hydrogen should be free from arsenic : the best means of ensuring this is to treat the dilute acid with sulphuretted hydrogen or with hydrosulphate of baryta.

When the air has been expelled from the apparatus, the tube is heated to redness, and a current of dry hydrogen carried through it ; when no more water is disengaged from the other end, it is allowed to cool, the disengagement still continuing, and the iron is not removed until quite cold, otherwise the reduced metal inflames.

The iron thus reduced, appears in small grey lamellæ, retaining the form of the crystals of oxide of iron used ; these are porous pseudomorphoses which are very readily pulverised.

The pulvis ferri thus obtained is a light grey, opaque powder, taking a metallic lustre when pressed with a polished body. Under the influence of heat, this powder rapidly takes fire, and becomes transformed into oxide. It quickly dissolves in water acidulated with sulphuric acid.

The reduction by hydrogen will be known to have been incomplete if the product has the least grey or black stain when removed from the tube.

The oxide of iron intended for this operation might be more simply obtained by calcining sulphate of iron; but M. Wöhler mentions that in this case the oxide is amorphous, and gives a gritty product, which is difficult to pulverise.

A more simple process of preparing pulvis ferri might be found by heating in a current of hydrogen the oxalate of protoxide of iron obtained by precipitating a concentrated solution of sulphate of iron by a hot, saturated solution of oxalic acid.

The reduction is performed at a sufficiently low temperature to be accomplished in a glass tube. The operation must, however, be finished with a considerable heat, otherwise the pulvis ferri becomes pyrophoric.

This iron, moreover, takes fire when hot; it is therefore necessary to let it become completely cold in the tube in which the reduction has taken place.—*Annalen der Chemie und Pharmacie*.

MODIFICATION in the PREPARATION of STORAX OINTMENT.

By M. HAINAUT.

ALMOST all pharmacutists must have had reason to complain of the too great firmness of storax ointment, especially in winter. This is the consequence of the quantity of wax which enters into its composition.

It is sufficiently consistent when composed thus:—

	Grs.
Colophane	250
Resin elemi	250
Yellow wax	60
Liquid storax	125
Olive oil	250

The only difference in these proportions from those of the formulæ is that half the wax is replaced by an equal quantity of oil.

I replace walnut oil by olive, because as M. Guibourt has remarked, the latter not being siccative, the ointment does not become dry on the surface.—*Journal de Pharmacie d'Anvers*.

THE CHEMIST.

ORIGINAL COMMUNICATIONS.

On the ELECTRO-CHEMICAL DEPOSITION OF METALS.—By A. WATT.

ELECTRO DEPOSITION OF BRASS.—*Continued from page 134.*

Electro-brassing Cast-Iron Work.—In preparing cast-iron work for the brassing bath, it will be necessary first to make up a “pickle” of the following:—

Sulphuric acid	1 lb.
Water	20 lbs.

The article is placed in the pickle bath and allowed to remain until the oxide of iron has become loosened from the surface of the article, in other words until a brush and sand will easily remove the oxide. If at any time the oxide is found to adhere firmly to the cast iron surface the pickling process must be continued until it yields readily to the brush.

When the work is very rusty, first place it in a pickle made of:—

Hydrochloric acid	1 lb.
Water	20 lbs.

and any parts which may have a thick coating of rust may be cleaned by applying a little strong hydrochloric acid to the part which readily dissolve the rust. These excessively corroded parts should first be treated with hydrochloric acid and then the article be placed in the pickle bath. Generally speaking from one hour to an hour and a half is long enough to remove the oxide of iron in the pickling bath.

As soon as the articles are pickled, they are to be well rinsed, and are then laid on a board, placed over a vessel of water, called the cleaning board, and are to be thoroughly brushed with a hard brush and sand and water, until all the oxide is removed from the surface of the articles. It is then to be rinsed again, and may be placed in a weak solution of carbonate of soda or potassa; it is then to be placed in the brassing bath, attached to the negative electrode of the battery.

For most purposes I prefer using two cells of a battery, consisting each of a stone jar, fitted with a cylinder of zinc inside, to which a copper wire is attached. A porous cell is placed in the centre, and a bar or plate of carbon is placed in this cell, which is then filled with nitric acid. Into the outer cell is poured dilute sulphuric acid, containing about half an ounce of acid to the gallon of water. A binding screw is attached to the carbon, and a wire proceeding therefrom is to be placed in connection with a brass anode.

When the article has been immersed in the solution for a few moments, a white foam will shew itself at the point of the wire in most instances, and frequently bubbles of gas will be seen to arise from every part of the article in solution. In electro-brassing, generally, but little deposition takes place unless there is the evidence of chemical action alluded to.

As soon as the article has received the required coating, which for ordinary purposes may be accomplished in about two hours with two cells of the battery just described, holding about four gallons in each jar, it is to be at once rinsed in hot water and placed in hot sawdust. When thoroughly dry, if it is required to bronze it, the article should be rubbed over with a leather and a little powdered pumice or whitening, in order to render bright those surfaces which are to expose the metal when the bronzing is complete, so as to give the effect of light and shade to the article; or the article may be cleaned and lacquered. The processes of bronzing have been described in a former article. [See THE CHEMIST, July, 1855, page 586.]

Electro-Brassing Wrought-iron Work.—It is more easy to electro-brass wrought than cast-iron work, as it is less porous, and is in general much more smooth. The articles may be first pickled in the sulphuric acid pickle-bath, and then be cleaned with a brush, sand and water. The solution in which wrought-iron is brassed need not contain quite so much metal as that for cast-iron, and generally it does not require the exposure of so great a surface of anode.

When the wrought-iron work is brassed it may be treated in the same way as cast-iron work. I have invariably found that wrought-iron would receive a given stoutness of coating in less time than cast-iron; therefore it need not be allowed to remain so long in the bath as that description of work.

If, when the work is first placed in the solution, it receives a deposit of too red a hue, rather more anode should be exposed; if, on the other hand, the work appears too pale, less of the anode should be immersed in the solution. The surface of anode exposed will generally influence the color of the deposit.

Electro-Brassing Articles of Zinc.—Goods of this description should first be placed for a quarter of an hour or so, in a pickle consisting of:—

Sulphuric acid	1 ounce,
Hydrochloric acid	2 ounces,
Water	1 gallon.

The articles may then be rinsed in clean cold water, and, being placed on the cleaning-board, they may be scoured well with a hard brush, sand and water. Lastly, the goods are to be rinsed and immersed in the bath. Zinc articles, if every circumstance is favorable, will generally receive the deposit immediately after immersion; when the reverse is the case, either the solution is deficient in conducting power, the battery weak, or the surface of anode exposed not sufficient. When the zinc goods are electro-brassed, they are to be rinsed in hot water, and should then be placed in hot sawdust. This class of work may then be bronzed, or polished and lacquered.

Electro-brassing Lead and Pewter Articles.—Lead does not receive the deposit quite so favorably as zinc, but pewter receives it tolerably well. They may, however, be both coated in the same bath without much fear of injury to the latter. Lead should be pickled in a dilute solution of nitric acid—say, a mixture containing about four ounces of nitric acid to a gallon of water. The article may be allowed

to remain in this pickle for half an hour, when it is to be rinsed, cleaned with sand, as before, and again rinsed in clean water. It is then ready for the bath, care being taken that a sufficient surface of anode be exposed to enable the article to receive the deposit immediately, otherwise it may remain in the bath for a long time before it becomes uniformly coated. Lead is very apt to receive the deposit in *parts*, owing to its being a very indifferent conductor of the current.

In brassing lead and pewter, the battery power employed should be stronger than that used for coating iron or zinc, and a greater surface of anode should be immersed in the solution. It is advisable, also, to raise the temperature of the solution to about 90° F., when it can be done conveniently. The same observations apply to the coating of tin with brass.

When a brassing solution has been worked for some time, it is apt to deposit either copper only or zinc only—generally speaking the former. The principal cause of this is that the solution has not the power of dissolving the anode equally, the copper in the alloy being readily attacked by the materials in solution, becomes dissolved and enters the solution, whilst the zinc, being liable to be converted into an insoluble salt, either remains on the anode in the form of a white mass or falls to the bottom of the bath, but little of it entering into the solution, consequently the latter, instead of depositing the yellow alloy deposits only, or chiefly, copper. When a solution is thus found to work unfavorably, it will be necessary to add a little more concentrated solution of zinc, or sometimes I have found that the addition of liquid ammonia to the bath has dissolved a considerable portion of the zinc precipitate from the anode, and thus the solution has been restored to its proper condition. When adding the liquid ammonia, which should be the strongest made, it is as well to add a little additional cyanide of potassium.

The solution may also be restored by separating the clear solution from the precipitate which has fallen to the bottom of the bath, and by then treating the precipitate with liquid ammonia and cyanide, which will dissolve a greater portion of it. The solution thus formed may be added to the other solution, which will then be found to work well again. Whenever the anode assumes the white appearance referred to, it will be necessary to add liquid ammonia, or cyanide of potassium, or both; otherwise, when the anode becomes coated with the white oxide of zinc, the operation will, to a great extent, become suspended.

Sometimes it will be found that the solution has become deprived of both zinc and copper, in consequence of the anode not re-supplying it with metal in the proportion in which deposition has taken place. When such is the case it will be necessary to make a little concentrated brassing solution, which may be added, gradually, until the bath is found to work right again. This concentrated solution may always be kept on hand and a little of it applied as occasion may require.

London, December 15, 1855.

(To be continued.)

CHEMICAL TABLES. COMPILED BY THORNTON J. HERAPATH.

No. IV.—Table showing the Behavior of Substances with Reagents, and for Testing by the Blowpipe:—Proximate Organic Analysis.

Distinctive Reactions are printed in *italics*. Precipitants used in quantitative analysis are distinguished by an *.

D'—ORGANIC SUBSTANCES:—BASES, &c.

CLASS II.—SUBSTANCES INSOLUBLE IN ÆTHER, BUT SOLUBLE IN ALCOHOL.

(Continued from p. 138.)

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
Amygdaline . . .	Veg.—Only in the kernels and leaves, &c., of certain species of <i>prunus</i> , <i>pyrus</i> , and <i>amygdalus</i> . Crystal., and very similar in characters to the pseudo-alkaloids; is almost insol. in cold alcohol, and is <i>decomp. by synaptase</i> (i.e., cold aqueous extract of sweet almonds), when the soln. is gently heated, and gives off hydrocyanic acid in vapor.
Caffeine, or theine .	Veg.—Only in coffee, tea, and a few other plants. Crys. in long prisms, and is sublimable. <i>When boiled with a mix. of chlorate of potash and hydrochl. acid, it is converted into a substance similar to alloxan, which stains the skin red, and on the addition of ammonia yields a beautiful purple soln.; with sulphate of iron and an alkali, a magnificent blue color is developed in the soln.</i>
Glutin	Veg.—In the seeds of the cereals, &c. <i>Is the only proteine compound (vide Class III.) sol. in alcohol.</i>
Leucine	Animal.—Only in the liver of the calf. $C^{12}, H^{13}, NO^4=131$. Crys. in scales (Funke's Atlas, p. iii., fig. 6). Heated with potash, it yields valerianic acid, which remains in combin.
Urea	Animal.—Only in urine, blood in cholera, &c. $C^2, H^4, N^2, O^2=60$. Crys. in long flattened 4-sided prisms. Taste, cooling and saline. <i>An aqueous soln. is converted by boiling into carb. ammonia; and when mixed with a few drops of strong nitric acid* yields a crys. ppt. of per nitrate of urea. With oxalic acid* it yields crystals of sp. sol. oxalate of urea; and with a soln. of the per nitrate of mercury* (Liebig's test) a heavy white ppt.</i> [Vide Otto Funke's Atlas, Caven. Soc., pl. ii., figs. 4, 5, and 6.]
Creatine	Animal—only in extract of flesh, and in urine. $C^9, H^{11}, N^3, O^6=149$. Forms brilliant, hard, prismatic crys. [Funke's Atlas, pl. iii., fig. 1.], only sp. sol. in cold alcohol, but readily sol. in boiling water. <i>By the action of acids, it is resolved into creatinine, and by the action of alkalis into sarcosine and urea.</i>

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
Creatinine . . .	Animal.—In urine, &c. $C^9, H^7, N^3, O^2=118$. <i>Yields a cryst. ppt. with chloride of zinc, which is readily sol. in hot water.</i> [Funke's Atlas, pl. iii., fig. 8.]
Allantoine . . .	Animal.—Calve's urine. $C^4, H^3, N^3, O^2=79$. Forms colorless crys. [Funke's Atlas, pl. v., fig. 4.] Sol. in boiling water. When boiled with alkalis, it is resolved into ammonia, which escapes, and oxalic acid, which combines with the alkali.
Bile (Cholate of soda) .	Animal. Sulphuric acid troubles, and on gentle digestion gives yellowish-brown resinous drops. <i>Concentrated on platinum foil, and mixed with grape sugar, and then tested with a little sulphuric acid, a fine but transient purple color is developed. Nitric acid turns it first green, then blue, violet, red, and finally yellow.</i> [For crys. form of various prod. of decomp. of the bile, vide Funke's Atlas; Taurine, pl. iii., fig. 4; Glycocholic acid, pl. iv., fig. 6; Cholic acid, pl. v., fig. 2, &c.]
SUGARS AND PSEUDO-SUGARS.	
Div. I.—FERMENTABLE; OR CAPABLE OF BEING CONVERTED, BY FERMENTS, INTO CARBONIC ACID AND ALCOHOL—GENERAL FORMULA, $C^{12}, H^9, O^9 + xAq$.	
	Sp. 1.—Glucose, or grape-sugar. Veg. and animal.—In various plants, and in the liver and blood; also in the urine in <i>Diabetes mellitus</i>. C^{12}, H^{14}, O^{14} (dried at 212°)=198. Is diff. crys., or crys. in mammillæ; the var. "<i>Chulariose</i>," of Dumas, is uncrys. <i>When digested with an alkal. mixture of potash or soda and sulphate of copper (Trommer's test), or of sulphate of copper, tartaric acid, and alkali (Barreswill's modif.*), it yields, even in the cold, a red or orange-yel. ppt. of sub-oxide of copper. Heated with an alkal. mixture of chromate of potash and alkali, it yields a fine green solu.; with bichloride platinum (or nitrate silver), tartaric acid, and excess of soda, a dark-colored ppt. of reduced metal. A slip of white merino, saturated with bichloride tin, when moistened with a solu. of glucose, and heated, becomes stained brown (Mauvigne's test).</i> When in solu. glucose rotates the plane of polarisation from right to left.* Dilute nitric acid converts it into saccharic acid; strong nitric acid, by heat, into oxalic acid. Sp. 2.—Cane sugar. Veg.—only in a few plants. C^{12}, H^{11}, O^{11} (crys.)=171. Readily crys. in flattened 6-sided prisms, with irreg. termin. Does not reduce Trommer's or Barreswill's solu., &c., in the cold; but when boiled

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
	for a short time with dil. acids or alkal. solu., it is converted into glucose, and then readily reduces those metallic solu. It turns the plane of polariz. from left to right. Sp. 3.—Eucalyptus sugar. Veg.—only in the <i>Eucalyptus</i>. C^{12}, H^{14}, O^{14} (crys.)=198 or double; but C^{24}, H^{28}, O^{28} (at 212°)=351. Cryst. in long prisms, like mannite. <i>Differs from grape-sugar in comp., and in being blackened and decomp. by alkalies; and from mannite in giving a brown solu. with sulphuric acid.</i> Sp. 4.—Mushroom sugar. Veg.—only in fungi. C^{12}, H^{13}, O^{13}=189. Very like glucose; but does not reduce copper solu.
Div. II.—SUGARS NOT FERMENTABLE.—PSEUDO-SUGARS.	
Extractive matter . . . Certain resins . . . Certain coloring matters	Sp. 1.—Mannite. Veg.—in several plants. C^{12}, H^{14}, O^{12}=182. Crys. in long colorless prisms. Does not reduce copper salts. <i>Is converted by nitric acid and heat into saccharic and oxalic acids.</i> Sp. 2.—Glycyrrhizine. Veg.—in liquorice root. $C^{36}, H^{52}, O^{12}, 2HO$? <i>Is uncrys. and intensely sweet. Is pptd. from its aqueous solu. by sulphuric acid.</i> Sp. 3.—Dulcose. Veg.—source unknown. C^{14}, H^{14}, O^{12}=194. Crys. very like mannite. Taste somewhat sweet. <i>Is converted by nitric acid into mucic acid.</i> Sp. 4.—Glycerine. Veg. and animal.—From fats and oils. C^6, H^7, O^5, HO=92. Uncrys.; forms a colorless viscid syrup. Taste, decidedly sweet. <i>By the action of heat it is decomp., yielding volatile acroleine, which attacks the eyes most powerfully. It exerts a reducing action on copper solu. like glucose, &c.</i> [Sp. 5.—Inosite, also is sp. sol. in alcohol.] Veg.—In almost all plants. <i>The alcoholic and aqueous solu., on repeated evap., leaves a yellow or brownish-yellow residus of insol. apotheme.</i> Vegetable. Are insol. in water, and in dil. acids, but are mostly sol. in alkal. solu., and re-precipitated by acids. <i>Vide various works on chemistry.</i> Veg.—As carthamine, rubian, &c. Animal—As carminic acid. <i>Vide various works on chemistry.</i>

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
CLASS III.—SUBSTANCES INSOL., OR BUT SPARINGLY SOL. IN ÆTHER AND ALCOHOL, BUT SOLUBLE IN COLD WATER.	
Sub-Class I.—Substances Soluble in Cold Water.	
Lactine, or milk-sugar . . .	Animal.—In the milk of animals. C^{24}, H^{24}, O^{24} (crys.)=360. <i>Crys. in hard white crys. Is diffic. fermentable. It reduces Trommer's and Barreswill's solu. like glucose; and is converted by boiling dil. acids into grape sugar; but by strong nitric acid into mucic acid, which is sol. in oil of vitriol with a crimson col.</i>
Inosite, or sugar of flesh . . .	Animal.—In the juices of flesh. C^{12}, H^{16}, O^{16} (crys.)=216. <i>Crys. readily in large laminæ, resembling Cholesteroline, with retreating angles [Funke's Atlas, pl. vi., fig. 6]. Possesses a very sweet taste. Does not undergo the vinous fermentation; and does not act like grape sugar towards the salts of copper, or bile and sulphuric acid.</i>
Asparagin	Veg.—Only in asparagin and a few other plants. C^8, H^{10}, N^2, O^8=150. <i>Crys. in long prisms. Acted upon by hyponitrous acid, it yields malic acid.</i>
Dextrine	Veg.—In almost every plant. <i>Is pptd. white, by alcohol, like gum: and is not colored by iodine. By the action of diastase and by boiling dil. sulph. acid, it is converted into glucose; and by strong nitric acid and heat, into oxalic acid.</i>
Gum (Arabin)	Veg.—In many plants. C^{12}, H^{11}, O^{11}=171. <i>Is almost tasteless; is pptd. by alcohol, by the dinacetate of lead, and by silicate of potash. It is not colored by iodine, and is converted by strong nitric acid and heat into mucic acid (vide Lactine.)</i>
Mucilage	Veg.—In linseed, <i>Althæa</i>, &c. <i>Very similar to the preceding, but differs from it in giving a very thick mucilaginous solu.</i>
Pectin	Veg.—In many plants. Comp. doubtful. <i>Is pptd. by alcohol, and is not affected by iodine. Is sol. in alkaline solu., and is converted by them into pectic acid, which may be pptd. by supersaturation with acid, as a colorless jelly.</i>
Gelatine	Animal.—From the skin and animal membranes. $C^{62}, H^{67}, N^{13}, O^{32}$? <i>Is very sol. in hot water, and the solu. generally gelatinizes on cooling. Tannin, greyish white flocculent ppt. Corrosive sublimate, no immediate ppt. Sulphate of platinum, brown viscid flakes. Acetates of lead, no immediate ppts. Per sulph. of iron, no ppt., except on boiling. Not pptd. by acids. By digestion with caustic potash is converted into glycine. [Funke's Atlas, pl. iii., fig. 5.]</i>

TRANSLATIONS AND ABSTRACTS.

ORGANIC CHEMISTRY.

RESEARCHES *on* PYROXYLINE.

By M. A BECHAMP.

In a Memoir presented to the Academy on the 4th of October, 1852, (*See THE CHEMIST*, Vol. iv., 3rd Series, 1852-3, page 108), I showed that by the action of ammoniacal gas on an ethero-alcoholic solution of pyroxyline, this substance is decomposed with formation of nitrate of ammonia and of a compound containing less nitric acid than pyroxyline, whose composition I represented by the formula



I have continued the study of pyroxyline, and, in a Note presented on the 25th of July, 1853, I announced the regeneration of the cotton of pyroxyline under the influence of protochloride of iron.

The present Memoir has for its object the more complete study of the action of alkalies and reducing agents on pyroxyline, and to ascertain the composition of this curious compound.

I have been led to undertake this work by the comparative study of the nitrated products which are obtained by the action of nitric acid on various organic matters.

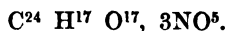
Indeed, when nitric acid acts on an organic substance in favorable conditions, it unites with it, with an elimination of water. But when we compare the action of the alkalies and of reducing agents on these combinations, we find that some, as nitrobenzine, are transformed into new nitrogenous products which contain all the nitrogen of the nitrated compound, whilst others, as nitric ether, regenerated the primitive matter, the nitric acid being eliminated in its natural state, or in the state of different nitrogenous compounds. Now, I have found that pyroxyline acts like nitric ether, and in general like the nitrates.

I have studied the action of the fixed alkalies and of ammonia on pyroxyline in the presence of water or in solution in alcoholised ether.

The action of caustic potassa on pyroxyline in presence of water consists, like that of ammonia, in removing the nitric acid and introducing combinations containing less nitric acid than pyroxyline, but this action is ill defined. The action of caustic potassa on pyroxyline leads to this certainly curious fact, that sugar is produced, which must be looked upon as formed under an alkaline influence, for this sugar does not pre-exist in pyroxyline, since under the influence of reducing agents it only regenerates cotton.

If the action of the alkalies is difficult to define when they act in the presence of water, it is not the same when they act on the ethero-alcoholic solution of pyroxyline. In this case, their action is very clear.

The caustic potassa removes the nitric acid, like ammonia, but the action is more profound, and a compound is formed whose composition is expressed by the formula



In this extract I shall not recur to the reduction of pyroxyline; I refer to the Memoir for the proof of the effective regeneration of the cellulose; I will only add two new experiments, which prove that pyroxyline is a compound of the nature of the metals.

1. When pyroxyline is treated with sulphuric acid with two equivalents of water, it does not dissolve, the temperature is not raised; we very soon perceive the odor of free nitric acid; and if, at the end of twenty-four hours, we dilute it with water, filter and submit the liquor to distillation, nitric acid passes over, without red vapor. Therefore pyroxyline contains nitric acid.

2. If, instead of reducing pyroxyline with protochloride of iron, we reduce it with acetate of the same base, binoxide of nitrogen is not disengaged, as with the chloride, but ammonia is formed, as may easily be proved by treating the filtered liquor with caustic potassa. Now, it is the same with the nitrates, for I have ascertained that by treating these salts with iron filings and acetic acid, their acid is converted into ammonia. Perhaps I may find in this fact a new method of estimating nitric acid.

This last fact may be compared with the action of acetate of iron on nitro-benzine. In the first case, all the nitrogen of the compound is eliminated in the salt of ammonia, as in the nitrates, and the primary matter is regenerated; in the other, on the contrary, all the nitrogen remains in the molecule of the new compound which is produced, aniline.

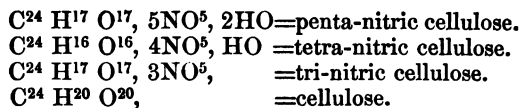
Thus, by the action of the alkali on one hand and by that of reducing agents, on the other, we see that there exists two distinct groups of nitric derivations, two groups which are far from being homogeneous.

The regeneration of the primary compound in one case, and the formation of a nitrogenous compound in the other, such is the character which enables us to distinguish these two groups of nitric derivatives.

The possibility of returning from the nitric derivation to the primary type is therefore the tie which connects with each other, nitric acid, nitro-glycerine, nitro-mannite, nitro-secula, nitro-quinite, nitro-cellulose, &c. All these relations are analogous, not to the nitrated compound of the nature of nitro-benzine, but to the others, to acetic ether, for example, and to the combinations of nitro-glycerine with the acids.

Hence, taking these principles as a basis, I think I may assign the following formulæ for expressing the constitution of the derivatives of cellulose, and give them names harmonising with their own.

The following are these formulæ and the nomenclature of these compounds:—



Comptes Rendus, No. 20, Nov. 12, 1855.

RESEARCHES ON NEW PHOSPHURETTED BASES.

By MM. A. CAHOURS and A. W. HOFMANN.

IN a book published by M. Paul Thenard (*See THE CHEMIST*, 1845, page 404), on the mutual action of hydrochloro-methylic ether and phosphuret of calcium, that chemist announced the existence of several products corresponding to the different compounds which phosphorus forms with hydrogen, in which this element is replaced by equivalent quantities of methyle. In this very interesting work, M. P. Thenard contented himself with establishing the formation of these different substances and with establishing their value by analysis, without making a profound study of them.

Since that period, the discovery of stibethyle by Löwig and Schweitzer, and that of Dr. Hofmann relative to the compound ammonias, demonstrate that in ammonia and its analogues hydrogen may be replaced, either partially or entirely by binary groups, such as methyle, ethyle, amyle, phenyle, &c., without causing them to lose their basic properties: moreover, as regards the compounds of arsenic and antimony, these properties are found to be considerably increased by the introduction of the foregoing radicals in the place of the hydrogen. On the other hand, the discovery of the tetra-methylated and tetra-ethylated bases, &c., by Dr. Hofmann, that of the corresponding bases of arsenic and antimony, made simultaneously by MM. Cahours and Riche, on one hand, and M. Landolt, on the other, demonstrate that we might go farther, and replace in ammonia the four equivalents of hydrogen which it contains by equivalent quantities of alcoholic radicals, and that besides there existed for arsenic and antimony compounds corresponding to ammonium.

It remained then to fill up the vacuum existing between the compounds of nitrogen and those of arsenic; the study of the phosphuretted combinations seemed to promise an ample harvest of facts: with this object, during a stay of a month in London, Dr. Hofmann and I undertook the experiments of which we have the honor of simply communicating the results to the Academy.

We first tried to produce the phosphuretted compounds corresponding to ammonia and ammonium by employing a course analogous to that followed by M. P. Thenard, replacing, however, the phosphuret of calcium with phosphuret of sodium, which is easily obtained by the direct union of sodium and phosphorus, and hydro-chloro-methylic ether by hydriodo-methylic ether. The action is very brisk with the aid of heat; moreover, inflammable and detonating products are formed, so that this mode of preparation is not unattended with danger, and we run some risk of losing the fruit of our work; finally, complex products are formed, the separation of which could be effected only with great difficulty. It is thus that we ascertained the existence of the compounds:—

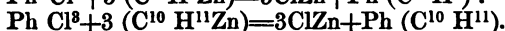
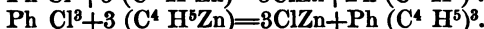
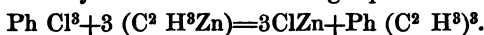
Ph Me², a liquid which corresponds to kakodyle;

Ph Me³, a liquid which corresponds to stibethyle and tri-ethylamine;

Ph Me⁴ I, a beautiful crystallised substance which corresponds to the iodide of tetra-methylammonium.

But this mode of preparation being too uncertain and furnishing mixtures, the separation of which was attended by enormous difficulties, we were obliged to seek some other method which should enable us to obtain with certainty some of the foregoing products in abundance and in the state of purity. The reaction which appeared to us most suitable for trying to solve the question was the reciprocal action of the terchloride of phosphorus Ph Cl^3 , and of zinc-methyle; the action of this same chloride of phosphorus on zinc-methyle and zinc-amyle should furnish, moreover, similar results: experiment fully confirmed our anticipation.

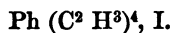
It is known that in making zinc react on the iodides of the alcoholic radicals, in the hope of isolating these radicals, Dr. Frankland discovered bodies of the highest interest, *zinc-methyle*, *zinc-ethyle*, and *zinc-amyle*, which act as true metals endowed with very energetic electro-positive properties. When any one of these curious compounds is introduced into a U tube filled with carbonic acid, through which vapors of terchloride of phosphorus are directed, the mass is powerfully heated, and we very soon obtain a viscid mass which solidifies on cooling. This solid mass is a compound of chloride of zinc with triphosphomethylamine, or triphosphethylamine, &c., according as zinc-methyle, zinc-ethyle, &c., has been used. These reactions are readily explained by means of the following equations:—



These compounds of chloride of zinc and of triphosphomethylamine, triphosphethylamine, &c., being distilled with an excess of a concentrated solution of caustic potassa, chloride of potassium and zincate of potassa were formed and remained in the retort, whilst volatile oils distilled over, possessing a peculiar odor, which calls to mind that of the arseniuretted bases, endowed with very distinct alkaline properties, and which analysis demonstrated to us as triphosphomethylamine, triphosphethylamine, and triphosphamylamine.

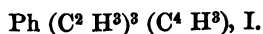
These bodies form with the acids, crystallisable and very soluble salts, their hydro-chlorates give with bichloride of platinum, compounds of an orange color, very soluble and left by a slow evaporation in fine crystals.

Triphosphomethylamine, put in contact with iodide of methyle, heats powerfully and gives a concrete matter, soluble in large proportion in alcohol, and separating by the evaporation of this liquid, under the form of long white needles, whose composition is expressed by the formula:—

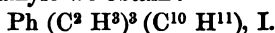


It is consequently iodide of tetraphosphomethylammonium.

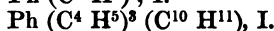
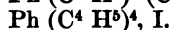
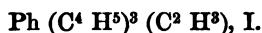
The iodide of ethyle acts in the same manner, but less energetically, and gives a combination isomorphous with the foregoing, represented by the formula:—



With the iodide of amyle we obtain :—

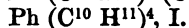
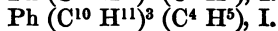
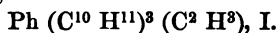


Triphosphethylamine treated in the same manner, by alcoholic radicals gives :—



The second of these compounds gives crystals of great beauty.

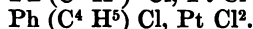
Triphosphamyline gives us in like manner the compounds :—



These iodides are easily decomposed by oxide of silver; we thus obtain iodide of this metal, and very soluble compounds, endowed with a very considerable alkaline power, and neutralising perfectly the most powerful acids.

These oxides neutralise hydrochloric acid very well, and give crystallisable compounds which form beautiful combinations with bichloride of platinum.

The chloroplatinates of tetraphosphomethylammonium and tetraphosphethylammonium gave us by analysis numbers which lead to the formula :—



Besides, the foregoing iodides treated by the salts of silver, nitrate, sulphate, &c., give, by double decomposition, iodide of silver and salts of the phosphammomuretted bases.

This mode of production, based on the very fruitful idea of double decomposition, having furnished results of the greatest clearness, we have substituted the terchloride of arsenic As Cl^3 for the terchloride of phosphorus Ph Cl^3 . We then obtained chloride of zinc and triarsenmethylamine, triarsenethylamine, &c.

The chloride of bismuth appears to act in an analogous manner; but the results are not nearly so clear.

We propose very soon to give more ample details concerning these products, and to make known besides the action of some other volatile chlorides on zinc-methyle and zinc-ethyle.

Comptes Rendus, No. 20, Nov. 12, 1855.

INORGANIC CHEMISTRY.

On the OXALATE of OXIDE of CADMIUM, and on the SUB-OXIDE of that METAL. By M. VOGEL, JUN.

As being analogous to the sub-oxide of lead which M. Boussingault obtained by heating the oxalate of oxide of lead, we have admitted the existence of a sub-oxide of cadmium since the experiments of M. Marchand, who produced it by means of the oxalate of oxide of cadmium.

Some experiments which I have undertaken on this subject have given me a result which differs in some respects from those of M. Marchand; I have therefore determined to publish them.

The oxalate of cadmium which I used in my experiments was obtained by the precipitation of the chloride of cadmium by oxalate of ammonia. The precipitate was washed until the decanted liquid was no longer rendered turbid by a solution of chloride of lime.

I first endeavored to determine the exact constitution of the salt.

My experiments with respect to the quantity of water in the salt differed in two points from M. Marchand's results.

1.—The salt, heated to 212° F. in a current of dry air, disengages its entire quantity of water; now, according to M. Marchand this temperature makes no diminution in the weight of this salt.

2.—When this salt is dried for fifteen days over sulphuric acid it is found to contain 3 eq. of water instead of 2 eq.

The analysis of this salt gives the following result.

			Calculated.	Found.
Cd O	.	63.7	50.3	50.4
C ² O ³	.	36.0	28.4	28.8
3aq	.	27.0	21.3	20.8
			100.0	100.0

To form the sub-oxide of cadmium in question I heated entirely dry oxalate of oxide of cadmium in a bath of melted lead, taking care that the temperature of the melted lead should not exceed the point of fusion of that metal. The result was a greenish powder, similar to oxide of chrome, as described by M. Marchand. But this greenish residue is not a sub-oxide of cadmium, it behaves more like a mixture of metallic cadmium and oxide of cadmium, as we shall see.

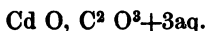
When this greenish residue is treated with dilute acetic acid, the oxide of cadmium dissolves immediately, and there remains a greyish residue of metallic cadmium. This residue appears under the microscope in small brilliant metallic globules of a different diameter, even when the decomposition of the oxalate of oxide of cadmium has been performed at the lowest possible temperature. It thence results that the greenish residue cannot be a chemical compound of the formula Cd^2O , but is rather a mixture of metallic cadmium and oxide of cadmium.

Further experiments proved to me that the temperature at which the decomposition of the oxalate of cadmium takes place, may have an essential influence on the nature of the residue.

The higher the temperature at which the oxalate of cadmium is decomposed, the less oxide of cadmium there is in the residue, instead of which, if the temperature is as low as possible, the quantity of oxide of cadmium in the residue is much greater. Likewise, in the most favorable circumstances, the oxalic acid is divided exactly into carbonic acid gas and oxide of carbon gas, and in this case the oxide of cadmium is left alone and perfectly pure.

From this it follows :—

1.—That oxalate of oxide of cadmium, obtained by the precipitation of chloride of cadmium by means of oxalate of ammonia, is composed according to the formula



2.—That this salt loses the whole of its water at a temperature of 212° F. with the assistance of a current of air.

3.—That the greenish residue after the decomposition of the oxalate of oxide of cadmium, hitherto regarded as a sub-oxide of cadmium, is a mixture of metallic cadmium and oxide of cadmium.

4.—That the relative quantity of the metallic cadmium and of oxide of cadmium in the residue, depends on the temperature at which the decomposition of the oxalate of cadmium is performed.

Journal de Pharmacie et de Chimie, November, 1855.

INDUSTRIAL CHEMISTRY.

On the PRODUCTION of BORACIC ACID in TUSCANY.

By M. PECHINEY-RANGOT.

BORACIC ACID is one of the most important mineral productions of Tuscany. It may be said that nature alone is at the whole expense of this interesting operation ; it separates the boracic acid, brings the solution to the surface of the soil, and evaporates it herself.

If we wish to form an idea, very imperfect it is true, of the natural phenomena attached to the production of boracic acid, we must figure to ourselves a little valley, with here and there little hillocks, bearing on their sides the traces of a perpetual destructive action whence the soil is generally covered with saline efflorescences of various colors ; between the hillocks are little basins with stone sides, filled with muddy water, continually agitated by jets of vapor proceeding from their own depths, and projecting the liquor sometimes to considerable heights ; then a thick cloud of vesicular vapor, proceeding from these basins, sometimes obscures the atmosphere and sometimes rises under the form of an immense column often lost in the clouds. Such, in a few words, is what at first strikes the eye of the visitor to the localities which produce the boracic acid. A feeling of horror and fear is united to these first impressions on examining this naked, calcined ground, which is, so to speak, eaten up on all sides ; ground on which we tread with hesitation and the fear of seeing it give way under our feet. And this feeling of terror soon gives place to admiration when we carry our attention to these immense sources of vapor, issuing with such force and impetuosity, and which probably have existed for millions of years, without the human mind being able to assign an origin to it, except by admitting some great geological revolution, such as our planet has not for a long time undergone.

The vapors which escape from the earth bear the name of *soffioni* (spouts). When a circular wall is constructed, which surrounds a

soffioni on all sides, and this basin is filled with water, the whole constitutes a *lagone*. The liquid in this *lagone* becomes by degrees saturated with boracic acid, and it has then only to evaporate to a certain point to obtain a crystallisation of this product. But, before going farther, let us say a few words as to the nature of these natural vapors, and the various products to which they give rise.

The immense quantity of steam which escapes from these *soffioni* is always accompanied by the following gases :—

Carbonic acid,
Sulphuretted hydrogen,
Ammonia,
Nitrogen (in very small quantity),
Hydrocyanic acid, (almost inappreciable traces).

To ascertain the presence of these gases in the vapors, they were collected at the end of a tube along the length of which was made a very incomplete condensation of a small jet of the vapor. The water of condensation, slowly evaporated in the open air, gave as fixed residue, boracic acid, a small quantity of an ammoniacal salt, and traces of an organic essential oil, precisely identical, at least in its physical characters, with that which is mixed with the crude boracic acid of commerce.* When evaporated in a retort, out of contact with the air, the only fixed residue was boracic acid, with a little of the organic substance.

The absence of sulphate of ammonia, when the evaporation of the vapor of the *soffione* is conducted without admission of air is easily explained: this vapor, as we have mentioned, is accompanied by hydrosulphate of ammonia; one portion is dissolved in the liquid, and, when evaporated in the open air, the other part is transformed into sulphate; whereas when the evaporation takes place out of contact with the air, this hydrosulphate distils with the vapor. This might at once explain to us the cause of the presence of sulphate of ammonia, as an impurity in the commercial acid; but we must return to this subject, which we shall treat in a peculiar manner.

It is with great timidity that we approach the question of the source of the vapor of these *soffioni* and the gaseous products which accompany them.

The phenomenon of these *soffioni* is so extended, so grand, that it is comparable only to something even more vast and grand, the volcanoes. Moreover, we find that the *soffioni* of Tuscany are connected with Etna and Vesuvius by an uninterrupted series of analogous phenomena. Going from Etna we come to Vesuvius, then to the Lipari Isles, in one of which, Vulcano, there are disengagements of mixed vapors formed of various gases, and in the neighborhood of which crystallised boracic acid is found, which was discovered and first mentioned by M. Lucas; then the gaseous disengagement in the grottoes of Pouzzoli; then, almost on the confines of Romagna, on the Road to Sienna, is a river, whose waters, which are tepid and charged with

* This organic substance appears to proceed from some schistous matters which the vapors pass through before coming in contact with the atmosphere.

sulphuretted hydrogen, remind us, though only slightly, at least in physical characters, of the waters of condensation of the vapors of the *soffioni*; and finally, these last, in some localities of which are found small analogous *solfatare*, but on a much smaller scale, of those of Naples.

All these things shew that the phenomenon of the *soffioni* is due to a cause which is identical with that of volcanoes; that is to say that the origin of the vapors of the *soffioni* is due to the central heat of our globe. At a certain depth into the interior of the earth, a certain quantity of liquid would continually accumulate which would be reduced into vapor by the heat of the surrounding parts, which vapor, being unable to return by the same path as the liquid which had produced it would always pass along its present outlets which lead to the *lagoni*. These outlets themselves may very likely be the last remains of some immense fissure produced by some geological catastrophe, such as an earthquake. The *soffioni*, which occupy a circumference of at least 40 kilometres, are all situated in a circular valley surrounding the heights of Castel Nuovo.

The gaseous products emitted by the *soffioni* form divers products which deserve some consideration, because to them is owing the general impurity of crude boracic acid. We would speak of the *efflorescences*, the saline, deliquescent, and variously colored crusts which gradually form upon the soil.

The explanation of the formation of efflorescences in the neighborhood of the *lagoni* is easily deduced from the knowledge of the nature of the vapor of the *soffioni*. This vapor always contains ammonia and sulphuretted hydrogen. In contact with the air and hydrosulphuric acid, it is transformed either into sulphurous acid which reacts on a certain quantity of hydrosulphuric acid, or into sulphur and water; but in each case there is a production of very finely divided sulphur, which, when exposed to moist air upon a hot soil, is soon transformed into sulphuric acid. One portion of this acid absorbs the ammonia always brought with the vapor which filters, if we may use the term, through the soil, and sulphate of ammonia is thus formed. Another portion of the sulphuric acid reacts on the soil itself, and according to the calcareous, dolomitic, or schisto-argillaceous nature of the latter, forms sulphates of lime, magnesia, or alumina. Moreover, this last, combining with the sulphate of ammonia already formed, produces ammoniacal alum. Finally, a little sulphuric acid frequently remains free.

If, in the locality in which these efflorescences are formed mud is found analogous to that brought mechanically by the vapor into the water of the *lagoni*, sulphate of iron is found in it; now if this mud contains a large quantity of sulphuret of iron which becoming oxidised in the air is transformed into sulphate, it likewise contains, first, sulphur proceeding from the decomposition of the sulphuretted hydrogen and which has escaped the oxidising action of the air, and, second, boracic acid, from the traces only which are brought by the vapors.

The efflorescences which we have just described are the most fre-

quent; there are others formed whenever any trenches are made in the soil itself near the *lagoni*, that is to say, in the black, humid, and hot soil of this locality.

But, in the first place, whence comes this black, soft earth? According to various observers it is certain that the vapors of the *soffioni*, before they reach the surface, must pass through pyritic argillaceous schists. In some kinds of the mud, such as, for example, that at Castel Nuovo and Monte Rotondo, we find perfectly crystallised specimens of iron pyrites; it is probably in passing over the iron pyrites, that these vapors, by the decomposition of a small portion of their water, produce magnetic oxide of iron and the sulphuretted hydrogen that they carry away with them. The mud which these vapors take into the *lagoni* is merely a mixture of disaggregated argillaceous schist, iron pyrites, and magnetic oxide of iron.

We are induced to attribute the formation of sulphuretted hydrogen in the vapor of the *soffioni* to the reaction of the vapor of water on pyrites, not only by the presence of finely divided sulphuret of iron and magnetic oxide in the mud of the *lagoni*, but also by certain striking differences existing between the different factories established for the extraction of boracic acid. At Lustignano, for example, the mud of the *lagoni* (and by mud we mean the finely divided solid matters brought mechanically by the vapors and which they mix with the liquid of the *lagoni*), is only in some instances mixed with sulphuret of iron, and as our hypothesis leads us to suppose, there is not that great odor of sulphuretted hydrogen there as in other establishments; and, moreover, the efflorescences whose primary element of formation is hydrosulphuric acid, are very small here.

We will now speak of the efflorescences formed in the soil of the *lagoni* in consequence of trenching. This soil is formed almost exclusively of the mud of *lagoni*; it consequently contains sulphuret of iron, which when brought into contact with the air is transformed rapidly in sulphate of protoxide, which is dissolved after its formation in a small quantity of accidental liquid. This solution is first imbibed by the soil, then rising to the surface by capillary attraction, is there evaporated, and leaves a saline crust of a greenish yellow, composed almost entirely of sulphate of protoxide of iron.

As for the boracic acid it is positively brought by the vapor itself. There are many circumstances which prove this assertion beyond question.

When in consequence of the falling in of the earth or other analogous causes, a *soffione* has been confined and has been unable to find an issue to the surface of the earth, the vapor under the effect of this pressure, deposits in the upper part of the canal which it occupies, and often in large quantities, a crystalline substance, soapy to the touch and of a fresh and acid taste. This substance is the natural polyborate of ammonia which M. Emilio Bechi, of Florence, has lately analysed, and to which he has given the name of *larderellite*. Deposits of this substance are found wherever the compressed vapors exist. They have a tubular form; at their upper extremity these tubes are often

much obstructed, and they then assume a round protuberant form which well explains the method of their formation. There are sometimes mixed in with them pieces of the soil in which the deposit is formed, and which are frequently very hard schists, disaggregated by the *soffione* itself, and which are then found imprisoned in the solid product, of remarkable compactness and strength, deposited by degrees by the vapor. The observations of the physical constitution of the *larderellite* and the circumstances in which it is found, would themselves form an unanswerable proof that boracic acid is brought into the waters of the *lagoni* by the vapor itself;* nevertheless we shall adduce another, based upon a circumstance which has hitherto been neglected, namely the presence of boracic acid in the water of condensation of the vapors which are intended to heat the evaporating apparatus.

Let us imagine a jet of vapor escaping from a crack in the earth, a *soffione* in fact; a large ditch is dug round it; then a square conduit is built, commencing at the interior of the ditch nearest the jet of vapor, and carried under the evaporating pans for the heating of which this vapor is intended to be used. The ditch is dug round the *soffione*, the opening by which the vapor escapes is filled with stones, at first large, then smaller; and finally the last layer of small stones is covered with hydraulic mortar, so as to close up the smallest interstices which could leave a passage to the vapor. The *soffione* can then only escape by the already prepared conduit, and which is commenced under the layer of mortar. A *soffione* thus rendered useful for heating an evaporating apparatus is termed a *soffione, coperto a vespajo*.

Under the pans which it is intended to heat, this vapor partly condenses, and the water produced by this condensation contains boracic acid. How would the boracic acid be brought into this liquid if the vapor of the *soffione* did not contain it? We think that this is a second conclusive proof that the boracic acid is brought by the vapor.

(To be continued).

On the PRODUCTION and PREPARATION of a GREEN COLORING MATTER.

By M. VERDEIL.

I HAVE succeeded in extracting from the plant of the artichoke and of several plants of the family of Synantherea, a green coloring matter very distinct from chlorophylle, and possessing peculiar characteristics, which assimilate it to the Chinese green described by M. Persoz. The process which I use to produce this coloring matter consists in causing air, ammonia and water, to act simultaneously on the bruised plant of the artichoke, or on certain parts of this plant (the flowers especially). This action appears to be identical with that which these same agents

* The superheated vapor dissolves or carries off an enormous quantity of boracic acid. I have had occasion to try the experiment, and I have ascertained that the use of superheated steam would probably be the best means to find boracic acid in an ore.

exercise in the formation of orchil. The resemblance is so great that I have been able to separate from the flowers of the artichoke, principally from the base of the petals, a white fecula which easily separates as a deposit. This fecula contains the greater part of the coloring matter of the artichoke. It is on this fecula mixed with water that I cause the simultaneous action of ammonia and the oxygen of the air by continually agitating the liquid. Extracts with boiling water from the head of the artichoke likewise give a magnificent green coloration. I have already obtained results which lead me to expect that this coloring matter might be rendered useful for dyeing and printing textile fabrics.

As soon as the coloration is completely formed, the liquid, which is alkaline from the presence of ammonia, may be precipitated by acetic acid. A voluminous green precipitate is then formed, which may be filtered on a cloth. This precipitate is soluble in ammoniacal water and carbonate of soda; it is a very beautiful green. Washed in hot water, pressed and dried, this precipitate looks like cakes of indigo; but it is green, and gives solutions likewise of a beautiful green.

I have also obtained lakes, but I have not yet completely finished studying them.

Comptes Rendus, No. 16, October 15th, 1855.

THEORETICAL SUMMARY on the ACTION of the ALKALINE SILICATES in the ARTIFICIAL PRODUCTION of HYDRAULIC LIME, CEMENTS, and SILICIOUS STONES.

By M. FRED. KUHLMANN.

I HAVE the honor of requesting the attention of the Academy for a short time, so as to complete my theoretical opinions as to the action of the alkaline silicates in the various reactions which I have mentioned at various times.

Artificial Hydraulic Lime.—When we put fat lime diluted with water in contact with a solution of silicate of potassa or soda, the potassa or soda are eliminated, and the silicic acid, combining with the lime, substitutes itself for one part of the water which impregnated it, and which formed with it a paste which was susceptible of being indefinitely diluted in that liquid. This combination gives to the lime the nature of a plastic matter, which, especially when it has undergone the action of heat, no longer whitens the water which bathes it. All the molecules of the lime are united by the silicious cement. When this lime, thus converted into a basic silicate, is used in buildings which come in contact with the air, it absorbs carbonic acid and is gradually transformed into silicio-carbonate of lime.

If aluminate of potassa or soda be substituted for silicate, analogous phenomena are produced.

Silicatisation of Plaster of Mortar of Lime.—When walls are washed with a solution of silicate of potassa or soda, an immediate reaction is produced by the transformation into silicate of lime of the hydrated lime making part of the plaster, let them be as old as they

may. One portion of the potassa or soda is eliminated. The silicate which, in its very formation, is found combined with carbonate of lime, thus forms a compound analogous to that given by exposure to the air to hydraulic mortar artificially obtained by the humid way. If the alkaline silicate is in excess, the reaction continues with the carbonate itself, by virtue of a property which we intend analysing.

Silicatisation of Porous Calcareous Stones.—Natural carbonate of lime, in contact with silicate of potassa or soda, behaves in some degree like caustic lime. Contact with an alkaline silicate eliminates the potassa or soda, and the silicic acid forms with the carbonate of lime the same silicio-carbonate whose formation we have previously mentioned as accompanying the hardening of hydraulic limes and fat lime plaster. It is always silicio-carbonate of lime which is formed.

This explanation of the phenomena which occur in these transactions is supported by the fact that in all these circumstances, even the last, there is an elimination of potassa or soda in the caustic state, and that the chalk, by its ebullition with the soluble alkaline silicates, removes from these silicates even the very least trace of silica, still retaining the carbonic acid which enters into its composition.

It is therefore necessary to remember that the calcareous carbonates exercise a basic action on the presence of silicic acid which has but very weak affinity for potassa or soda.

There is therefore a very intimate connexion between these phenomena, which all tend to one result, the formation of a hydrated silicio-carbonate of lime susceptible of losing successively its water of hydration and of acquiring the hardness characteristic of hydraulic cements.

Silicatisation of Plaster.—The action of the soluble silicates on plaster differs essentially from that which the silicates exercise upon calcareous stone; the phenomena are not the same, and we must add that the results, as to practical application, are more uncertain, and consequently more difficult to obtain.

The alkaline silicates, in contact with sulphate of lime, give rise to a double decomposition; with silicate of lime sulphate of potassa or soda is formed.

Now we know that this last salt, by its crystallisation tends to destroy the porous calcareous stones; it is even used to test friable stones. In hardening plaster, the first precaution is therefore to employ, exclusively, silicate of potassa. But this is not a serious inconvenience; the action of the alkaline silicates on porous calcareous stone is a slow and gradual action which is extremely favorable to the consolidation of silicious molecules, whereas that which these salts exercise on plaster is rapid and in some respects instantaneous; whence results a great puffing up which gives great porosity to plaster when mixed with the silicious solution, and which soon leads to the separation of scales when we operate on moulded or worked plaster.

Moreover, whenever I have spoken of the application of soluble silicates to harden plaster I have always insisted on the necessity of

using much weaker solutions than those which are applicable to the hardening of calcareous stones.

With respect to hardening plaster, it is to be regretted that silicatisation with hydrofluosilicic acid likewise has the great inconvenience of leaving some sulphuric acid in the mass, which is liable to spoil its solidity.

Silicatisation of Fresco Paintings.—When my methods of silicatisation are applied to fresco paintings, the phenomena are precisely the same as those mentioned with respect to silicatisation of fat lime mortars. It is well known that for this painting, colors rubbed up in water are applied on a plaster of fat lime and sand before it becomes firm, and that the colors are thus fixed by the carbonate of lime itself, crystallised pellicles of which envelope the colors and give them a peculiar vaporious appearance, which gives great artistic value to this kind of painting.

When we wash the surface of walls covered with pictures, the superficial portions of the mastic of fat lime assume the composition and properties of hydraulic cement, and acquire that degree of hardness.

Silicious Painting.—In this kind of painting with colors rubbed up with silicate, the carbonates and oxides which compose the colors combine gradually with the silicic acid, and the potassa or soda are displaced. If the color is an inert matter, not susceptible of chemical combination, there is produced, by the action of the carbonic acid of the air, a silicious paste which constitutes an extremely adherent cement, and which soon acquires, by the elimination of the alkalies, a perfect insolubility.

When these paintings are applied to walls plastered with lime, or formed of calcareous stone, the adhesion becomes more complete, the alkaline silicate acting at once on the coloring matter and the carbonate of lime of the wall.

In the latter case it becomes essential to avoid any weakening of the color of the silicious cement, to wash the wall, previously to the application of the colors, with a dilute solution of alkaline silicate.

In the same way as for plaster, there are colors whose nature would be powerfully and deeply modified by their contact with the alkaline silicates; in this manner white lead, chromate of lead and some other salts which become transformed into gelatinous silicates, should be avoided as well as those altered by the alkaline reaction of the silicates.

Silicious Printing.—When the silicates are well saturated with silica, the paper which is printed on is unaltered, but we have yet to ascertain whether time will produce any reaction.

As for printing on textile fabrics, after exposure for some time to the air, the silica is fixed, and washing will remove the potassa or soda.

Those portions of silicate which may have retained their solubility may be fixed by a slight soaping or bath of common salt, this body being susceptible of forming with the alkaline silicates a compound almost insoluble in water.

Silicious Injection.—By extending the application of the soluble silicates, as I have done since 1841, to the artificial injection of all

porous stones, and in general of organic and inorganic matters, there is no longer reason to attribute the hardening of these bodies to any other reactions than to the decomposition of the silicates by the slow action of the carbonic acid of the air and the gradual contraction of the silica; this is what I now do, and this has suggested to me some considerations on the formation of neutral, silicious, or albuminous pastes, and in general on the mineral species formed by the humid way.

Comptes Rendus, No. 23, Dec. 3rd, 1855.

On the MANUFACTURE of IRON. By Professor CRACE-CALVERT.

PROFESSOR CALVERT then submitted a communication on the Manufacture of Iron by Purified Coke. After pointing out what were believed to be the causes of the inferiority of iron, in many works, apart from the varying qualities of the ores, the injurious action which an impure fuel had upon the quality of the iron was particularly alluded to; and the necessity of removing the sulphur from the coal, or coke, when employed in the blast furnaces, before it could be imparted to the cast iron during the process of smelting, was strongly enforced. Professor Calvert then referred to several instances in which the quality of iron, after the application of the chloride of sodium in the blast furnace, had been greatly improved. These improvements were described to have been effected, at a very small cost, by the following simple process. If the blast furnace was worked entirely with coal, chloride of sodium was added, with each charge, in proportion to the quality of the ore and flux employed; but a better result was produced, if the coal was previously converted into coke, and an excess of the chloride was used in its preparation, in order to act on the sulphur of the coal, and of the ore, should any be found therein; and a greater improvement was manifested in the quality of the iron, when only coke so prepared was used in the blast furnace. The coke, so purified, emitted no sulphurous fumes when taken out of the coke oven; nor, when extinguished with water, did it give off the unpleasant odor of sulphuretted hydrogen, nor was there any sulphurous acid gas liberated, during the operation of smelting iron in the cupola, or in raising steam in the locomotive boiler, by coke so prepared; and it was stated that these decided advantages were gained, in some cases, at an additional cost of only one penny per ton of fuel. Professor Calvert then gave the results of a series of experiments which had been made upon trial bars one inch square, cast from iron melted in the cupola, with coke prepared by his process. He exhibited specimens of the iron so prepared, when the closeness of texture and the absence of the "honey comb" appearance, prevailing in the iron cast with the ordinary coke, was clearly demonstrated. The mode of experimenting was described, and the results were given very elaborately, and it was shewn that the average increase of strength was from 10 to 20 per cent. Taking the mean of the whole experiments, the following conclusions were arrived at:—The mean breaking weight of the bars, 1 inch square,

smelted with the improved coke, was 515·5 lbs.; ditto, with ordinary coke, 427·0 lbs.—equal to 88·5 lbs. in favor of the castings produced from the improved coke, or in the ratio of 5 : 4. The experiments on the bars smelted with the improved coke, indicated iron of a high order as to strength, and might be considered equal to the strongest cold blast iron. The metal appeared to have run exceedingly close, and exhibited a compact granulated structure, with a light grey color.

Dr. PLAYFAIR stated that Professor Calvert had received the gold medal at the Exhibition in France for his improvements in the manufacture of iron.

AGRICULTURAL CHEMISTRY.

REPORT on a WORK of M. GEORGES VILLE, the object of which is to prove that the NITROGEN of the ATMOSPHERE is ASSIMILATED in VEGETABLES.

By MM. DUMAS, REGNAULT, PAYEN, DECAISNE, PELIGOT and CHEVREUL. (Reporter).

(Continued from page 170.)

RESULTS OF THE EXPERIMENT MADE IN THE GLASS CASE.

Crop of the Pot No. 1.—This crop was very unequal; one plant was 1 decimetre in height, whilst the size of the others was only from 2 to 4 centimetres.

The roots, in escaping into the water by the holes in the pot, were exceedingly ramified, forming what is called *the fox's tail*.

The crop dried in vacuo weighed 2·242 gr.; it represented 0·0097 gr. of nitrogen.

Now, as the seeds contained 0·0099 gr. it must be concluded that no nitrogen was fixed in the plants, beyond that of the seeds.

This result is remarkable in this, that the weight of the seeds is to that of the dried crop : : 1 : 7.

Crop of the Pot No. 2.—This crop was more uniform and much finer than the foregoing.

Dried in the dry vacuum, it weighed 6·021 gr.; consequently, the weight of the seed being 1, that of the dry crop was 48·5.

The crop containing 0·0530 of nitrogen, and the seeds only 0·0038 it follows that the plants had gained 0·0492 of nitrogen.

Crop of No. 3.—This crop, although superior to that of No. 1, was much inferior to that of No. 2. Indeed, dried in vacuo, it weighed, 1·506 gr.; consequently, the weight of the seed being taken as 1, that of the crop would be 12.

The crop containing 0·0110 of nitrogen, and the seeds 0·0039, it follows that the plants had gained 0·0071 of nitrogen.

We may mention that, before the experiment, the pots, bricks, and sand of Etampes had been heated to redness, and that we had ascertained, before introducing them into the glass case and into the bell glass, that they contained no ammonia, at least, by heating 40 grammes

of each of these matters into a tube with *soda-lime* and receiving the product into normal dilute sulphuric acid.

It may be mentioned that all the water which had been in the glass case, united, represented 60 litres, and that a considerable quantity of distilled water had been kept in reserve to be used in the experiment, in order to examine comparatively and at the same time after the experiment these two portions of water.

It was agreed that M. Peligot should determine the quantity of ammonia which they respectively contained, in his laboratory of the Conservatoire, and that the residues obtained from the evaporation of 12 litres of each of the waters made by M. Cloez in the laboratory of the Museum, to which 12 litres had been added before the evaporation, should be conveyed to him.

The evaporations lasted, one four and the other three days. They were commenced by M. Cloez and M. Stoësner, M. Ville's assistant. Unfortunately, M. Cloez having learnt that his father was seriously ill, set out for Lille, and during his absence some of the young people who work in the laboratory of the Jardin des Plantes evaporated some ammoniacal liquors resulting from preparations of nickel. The residues of the two evaporations given to M. Peligot contained per litre :—

The distilled water <i>before</i> the experiment	. 0.0038
The distilled water <i>after</i> the experiment	. 0.0013

For the sake of truth, we give in a note a letter in which M. Cloez mentions this incident to M. Chevreul.

However, two evaporations of 10 litres each of the waters were made over a wood charcoal fire at the Ecole Polytechnique, by M. Cloez, and two new evaporations were made over a gas flame by M. Cloez, in M. Ville's laboratory, at Grenelle, by means of an apparatus in which the evaporating capsule was sheltered from dust: the volume of the liquid evaporated was 5 litres.

The nitrogen of the residues of these new evaporations was determined by M. Peligot.

Residues of the water evaporated over the charcoal fire, by M. Cloez.

Distilled water <i>after</i> the experiment	. . 0.00130 gr.
„ „ <i>before</i> „	. . 0.00066

Excess of nitrogen in the water of the glass case 0.00064

Residues of the water evaporated over the gas flame, in M. Ville's laboratory, by M. Cloez :—

Distilled water <i>after</i> the experiment	. . 0.000520
„ „ <i>before</i> „	. . 0.000087

Excess of nitrogen in the water of the glass case 0.000433

The water which had been in the glass case and the distilled water kept for comparative examination, had each been placed in corked flasks and sealed with wax.

RESULTS AND CONSEQUENCES OF THE EXPERIMENT MADE IN THE GLASS CASE.

By multiplying by 60 the quantity of nitrogen in a litre of water, we shall have that contained in the 60 litres of water experimented on before and after the experiment.

From the result given by the evaporation made at the Museum, we have :—

<i>Before</i> the experiment	.	.	.	.	gr. 0·228
<i>After</i> the experiment	.	.	.	.	0·078
					0·150

The difference 0·150 gr. would suffice for explaining the increase of nitrogen in the cup, since the latter was for the whole of the crops of the pots Nos. 2 and 3, only 0·0563 gr.

But the results are quite the contrary if we admit the determinations made over the charcoal fire and the gas flame, since the water, after the experiment, contained more ammonia than it did before.

Such are the results and consequences of the experiment made in the glass case.

We now pass to those of the experiment made in the bell glass.

RESULTS AND CONSEQUENCES OF THE EXPERIMENT MADE IN THE BELL GLASS.

We have seen (page 170) that a second experiment was commenced on the 30th of August, in a bell glass placed between the glass case and the aspirator.

In 700 grammes of sand of Etampes, previously calcined, and mixed with two gr. of cress seed ashes, were sown 100 seeds of this plant, weighing 0·206 gr., and representing 0·0063 gr. of nitrogen. The water with which the sand was moistened amounted to $1\frac{1}{2}$ litres.

The bell glass which covered the pot, luted on to a zinc plate by means of a cement, as we have said, was not removed until the 17th of October, at which period the plants were in flower. The water was not removed during the experiment; it was received in the pan of a reservoir placed out of the bell glass, as we have said.

The following are the results of this experiment.

The crop, represented by 91 plants dried in vacuo, weighed, with the remains of the seeds which had not germinated, 3·598 gr.; it was therefore to the weight of the seeds as : 17·47 : 1.

It contained	.	.	.	.	gr. 0·0350 of nitrogen
The seeds contained	.	.	.	.	0·0063

Excess of nitrogen 0·0287 in the crop.

Now, carrying matters to the extreme, let us suppose that the litre and a half of distilled water contained before the experiment, the quantities of ammonia found in the first place in the water used in the

experiment of the glass case; it ought, in conformity with this supposition, to have contained:—

<i>Before</i> the experiment	.	.	.	.	0.0057
<i>After</i> the experiment	.	.	.	.	0.0020
					0.0037

Still following up the supposition, the water would have yielded to the plant 0.0037 gr. of nitrogen; hence, deducting this quantity from the nitrogen of the crop, there remains an excess of 0.0250 gr. Consequently the nitrogen of the seeds would be to that of the crop, deducting the ammonia of the water, : : 1 : 3.971; that is to say, in round numbers, as 1 to 4.

It is not useless to remark that the crop to the seeds in the bell glass was as 17.5 to 1, whilst the crop of No. 2, placed in the glass case, gave the proportion of 485 to 1; the difference was attributable, at any rate in great measure, to the duration of the experiment in the bell glass, having been from August 30th to October 17th, whilst that of the experiment made in the glass case was from August 4th to October 12th.

It is also not unimportant to remember that in the crop of No. 1 of the glass case, in which there was no increase of nitrogen, the weight of the crop was to that of the seeds as 7 : 1.

Finally, we may say to those who admit that in the experiment of the glass case the water exerted no influence in augmenting the weight of the nitrogen of the crops of pots, Nos. 3 & 2 :

1.—That in the crop of No. 3, which was to the weight of the seeds as 12 : 1, the weight of the nitrogen of the seeds was to that of the crop as 1 : 2.81. The nitrogen in excess to that of the seeds was then as 1.81 : 1 :

2.—That in the crop of pot No 2, which was to the weight of the seed as 48.5 : 1, the weight of the nitrogen of the seed was to that of the crop as 1 : 13.95. The nitrogen in excess was therefore to that of the seed as 12.95 : 1 :

3.—That in the crop of pot No. 4, which was to the weight of the seed as 17.47 : 1, the weight of the nitrogen of the seeds was to that of the crop as 1 : 55. The nitrogen in excess to that of the seed was then as 4.55 : 1.

GENERAL REFLECTIONS.

A few reflections will not be out of place as to the manner of conducting the experiment to which living bodies are submitted with the intention of discovering the cause of the phenomena by which they are distinguished from inanimate bodies; for the more interesting this subject of investigation is, the more important is it to estimate the difficulties which tend to keep the investigator from the truth, the constant object of his efforts.

The first rule to be observed in every investigation of this kind, is that the condition in which the living bodies so experimented on shall

be placed, shall disturb as little as possible the function which they exercise in the ordinary circumstances of their life: otherwise the result of the experiment could not be regarded as definite.

For example, in order not to travel out of the subject under consideration, such is the result of the experiments made in a limited atmosphere in which the vegetation is followed up from germination to putrification. Evidently, if our seed in a normal vegetation gives a dry crop, the weight of which may be 100, 200, or 300 times as great as its own,* we may not form a conclusion from the case in which the weight of the crop exceeds that of the seed only 1, 2, 3 or 4 times, as the case in which the vegetation is accomplished in ordinary circumstances. Now, this is precisely what happens when the germination takes place in calcined sand, and in vessels in which, the air not being renewed, the circumstances are so different from those in which plants vegetate in the open air.

In order to arrive at a just appreciation let us follow the vegetation in the various circumstances in which it may be effected in agriculture, and from that it will be possible to deduce consequences calculated to elucidate the theory of what occurs in the two cases which we have distinguished, as to the manner of solving by experiment the question as to whether the gaseous nitrogen of the atmospheric aids in increasing the weight of plants.

We will re-state these two cases:—

The first regards plants placed in a very limited atmosphere which is not renewed.

The second regards plants placed in an atmosphere which is renewed, and which, moreover, contains proportionally more carbonic acid than the atmosphere.

(To be concluded in our next.

On the ACTION of SALTPETRE on VEGETATION.

By M. BOUSSINGAULT.

THE influence of saltpetre on the development of plants is at once most decided and most favorable; this property was not unknown to the ancients, and if the employment of this salt in agriculture has not become more general, the cause must be found in the high price at which it is sold at a distance from the place of its production, especially when a heavy duty is added to the great expense of its carriage. Moreover agriculturists did not enter into the question with any resolution until the discovery of large quantities in Peru. The knowledge of this great discovery reached Europe in 1821. The analysis of the nitrate was first made at the Ecole des Mines, at Paris, by a young Peruvian, M. Mariano de Rivero, and one of the most illustrious members of the Academy, the Abbé Haüy, determined the crystalline form.

* The Marquis of Turbilly has proved that a grain of rye, which had germinated in an old ant hill, gave 1440 very fine grains of rye. (*Memoirs sur les enrichissements*, pp. 217 and 218.)

These immense masses of nitrate of soda, common salt and borate of lime, are found in an arid plain in the province of Taracapa, between the 19th and 22nd degrees of south latitude, about eight to ten leagues from the coast.

La Pamba del Tamaragual, about 1000 metres above the level of the Pacific Ocean, and formed of alluvium, conglomerates and fossil wood of a very recent period, contains masses of saltpetre which are considered inexhaustible. These collections do not extend beyond six leagues of the sea shore; beyond this limit nitre is replaced by common salt.

The Peruvians call the saltpetre mixed with sand and clay *caliche*. These mixtures contain from 20 to 65 per cent. of nitrate. The crystallised white *caliche* is pure saltpetre, and in some places it is so hard and compact that it requires to be blasted with gunpowder to remove it. The *caliche* forms layers of 2 or 3 metres in thickness, over a space of from 80 to 400 metres; to extract the nitre, it is treated with boiling water; the solution is evaporated either with fire or the heat of the sun, and when the salt is dry it is sent to the port of Iquique, whence it is shipped to Europe or the United States. According to M. de Rivero, the value of the saltpetre at Iquique, delivered by the workers of Tamaragual, when there is much demand, is 25 francs the 100 kilogrammes.

The saltpetre of the province of Taracapa has only been extensively worked since the year 1831. Within the last five years the exportation has exceeded three millions of quintals (Spanish weight).

It is remarkable that before the conquest the Peruvians never used this saltpetre. Nevertheless the Incas possessed very great practical knowledge of agriculture. The attentive observation of the circumstances accompanying the cooling occasioned by the nocturnal radiations, taught them to preserve their fields from the effects of frost by troubling the clearness of the atmosphere by means of smoke; they fertilised the earth with guano, prepared an active manure with dried fish and human excrements, which they distributed in small quantities at the root of each plant of maize.

The good effects of nitrate of soda on farms, which receive from 120 to 125 kilogrammes per hectare, can no longer be doubted, after the comparative experiments made in England by Mr. David Barclay, and in France by M. Kuhlmann; and we may safely affirm that of the considerable importations of saltpetre from Peru into England, the portion bought for agricultural purposes, which is already very large, is daily on the increase.

The fact once acknowledged that the nitrate of potassa and soda contribute powerfully to the development of plants, we still have to ascertain how they act. Do they behave like the other alkaline salts, which are always found so efficacious in improving vegetation? Or, in consequence of their complex constitution, do they act in a manner more similar to manure obtained from animal substances, as, for example, the ammoniacal salts? These questions are certainly important, and I have made some experiments which I hope will assist in solving them.

The only explanation with which I am acquainted of the useful effect of the nitrates on vegetation, is that of M. Kuhlmann. This skilful chemist, depending upon the interesting investigations which have proved the production of ammonia by the action of nascent hydrogen on nitric acid, came to this conclusion; that when the nitrates aid in fertilising the soil, their nitrogen, before being absorbed by the plant, is transformed, most frequently, into ammonia in the soil itself. It is therefore sufficient, adds M. Kuhlmann, to prove the great utility of the nitrates, that these salts should be placed under the deoxidising influence of putrid fermentation, whose definitive result should be carbonate of ammonia. It is to be regretted that M. Kuhlmann should not have sought whether organised matters really, in purifying, transform the nitric acid of the nitrates into ammonia; this investigation being rendered all the more opportune from the ease with which the nitrogen, forming a constituent of ammonia, is changed into nitric acid. It is indeed on this tendency to oxidation of the elements of ammonia that is founded the most plausible theory of the nitrification of a soil in which are combined animal matters and alkaline bases.

I have therefore determined to examine whether the presence of putrescible organic matters in the soil were indispensable to the assimilation by the plant of the nitrogen of the nitrate; for should the assimilation take place in their absence we might thence draw two conclusions: one, that it is not necessary that the nitrogen of the nitric acid should previously be transformed into ammonia, out of the vegetable, to become fixed in its organism; the second, that in their effects on vegetation, the nitrates do not behave simply like salts with a base of potassa and soda.

The process to be adopted naturally consisted in causing a plant to grow in sand rendered sterile by calcination, adding to it a known quantity of alkaline nitrate and ashes; and watering with pure water. Should the plant develop itself, it must be analysed, and to ascertain the nitrate that it absorbs, the nitrate remaining in the sand must be most carefully determined.

Here a difficulty presented itself; to attain a satisfactory degree of precision, a very considerable amount of the sand must be analysed; the best way would be to analyse the whole; but as the operation would become almost impracticable should the amount of the soil be considerable, I was obliged to limit that amount; and to appreciate the influence which the volume of soil rendered sterile might exercise on vegetation, I repeated experiments made in the open air, mentioned in my last Memoir, increasing in some degree the quantity of the sterile soil. These experiments were tried on a lupin and on a cress. I shall only give the results of the first observation.

Experiment on the Lupin.

Soil of sand and quartz pebbles	.	.	.	1524	grs.
Flower-pot of baked clay	.	.	.	513	
Sand and pot	.	.	.	2037	

On the 10th May I planted a lupin weighing 0·302 gr. The plant developed itself in the open air; but measures were taken to shelter it from rain. The flower-pot was put on a china plate, 1 metre above the ground. To the calcined sand were added 1·3 gr. of washed ashes, and 0·2 gr. of alkaline ashes.

The plant was watered with water saturated with carbonic acid gas.

The experiment was brought to a close on the 2nd August, when the cotyledons had withered, and some of the lower leaves were becoming discolored. The plant measured 12 centimetres in height; it had fourteen leaves; when dried it weighed 1·415 gr. namely five times as much as the seed.

Analysis indicated:—

In the dry plant nitrogen	0·0166 gr.
The analysis of the sand was made on a tenth:—	
Nitrogen in the tenth, 0·00039 gr. In the whole	0·0039 „
	0·0205 „
Nitrogen in the seed	0·0170 „
Gain in three months vegetation	0·0035 „

This is nearly the same result as that obtained last year when the plant vegetated in one-tenth of the quantity of soil.

In this experiment, performed in the open air, exposed to the sun, with sometimes a considerable degree of wind, a great deal of water was consumed. But as this water did not contain appreciable traces of ammonia, as the ashes added to the calcined sand contained neither cyanides nor nitrogenous charcoal, it is unnecessary to introduce any corrections; the result was deduced directly from the numbers given by the analyses. An essential condition, for in my opinion, an experiment of this nature is evidently spoilt when, in consequence of the agents used in the development of the plants, we are forced to have recourse to corrections.

Reassured as to the influence exerted by the mass of a sterile soil on the vegetation, I have kept the weight of the sand in which the plant is to grow within such limits that the analysis of it may be made by operating on a third or on half, so as to multiply as seldom as possible any errors inherent to the process. The weight of the soil has been from 200 to 300 grammes.

First Experiment.—*Influence of Nitrate of Potassa on the Vegetation of the Helianthus.*

Two seeds of the sunflower, weighing together 0·062, were planted on May 10th 1855, in calcined sand, in which were mixed 0·1 gr. of alkaline ashes, 1 gr. of washed ash and in portions during the course of the experiment 1·11 gr. of nitrate of potassa. The sand was moistened in the first instance with pure water, and after the germination the water employed was saturated with carbonic acid. The plant was grown in the open air under a glass roof to preserve it from rain and dew. This arrangement was used throughout these experiments.

20th May. The seeds appeared above the soil; from this time the plant made rapid progress.

19th August. One sunflower had attained a height of 72 centimetres, and exhibited nine fine leaves with a flower-bud; six faded leaves adhered to the lower part of the stem. The other plant was 50 centimetres; had on it ten beautiful green leaves and seven faded leaves.

22nd August. The top of one plant having been accidentally broken, the experiment was terminated.

The two plants after dessiccation weighed 6.685 grs.

Woody stalks	.	.	.	.	.	3.990	gr.
Leaves	.	.	.	.	.	1.635	gr.
Roots	.	.	.	.	.	1.060	gr.
							6.685

Estimation of the Nitrogen in the Plants and Soil.

In consequence of the presence of the nitrate, the nitrogen was estimated by the method of combustion with oxide of copper.

One gramme of the dried plant was operated on, containing:—

Stalks	.	.	.	.	.	0.597	gr.
Leaves	.	.	.	.	.	0.244	gr.
Roots	.	.	.	.	.	0.159	gr.
							1.000

I. Matter 1 gr. Weight of Nitrogen found	0.01705
II. id. id.	0.01672
III. id. (Estimated with soda lime)	0.01560

According to the analyses made by this method of combustion, we find that the 6.685 grs. of dried plants contained:—

Nitrogen	0.1126
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The sand and the pot weighed 242.80 gr.

In three operations, in which 121.40 grs. of matter, were analysed, we obtained 0.0226 gr. of nitrogen.

For the whole	0.452
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The two seeds planted May 10th, weighing 0.062 gr. contained 0.0019 gr. of nitrogen.

Let us now compare the quantity of nitrogen introduced by the nitrate of potassa with that found in the plant and in the soil:—

In the dried plant: nitrogen	0.1126	} gr.
In the soil	0.0452	
In 1.110 gr. of nitrate of potassa	0.1536	
In 0.062 of seeds	0.0019	
Difference		+0.0023

Thus, in this experiment, during a vegetation of nearly four months we have found in the plant and in the soil, within 2 milligrammes, the nitrogen brought by the nitrate of potassa, and the gain in nitrogen, if gain there be, does not exceed 2 milligrammes.

If the plant had taken from the nitrate all the nitrogen contained in its albumen, casein, &c., it should have absorbed 0.8026 gr. Now, as each equivalent of nitrate, in penetrating into the organism of a vegetable, takes with it 1 equivalent of alkali, it thence results that in fixing 0.1126 gr. of nitrogen, the helianthus should receive 0.3741 of potassa.

By the examination of the ashes we have ascertained that the 6.685 grs. of dry plant should contain 0.419 gr. of alkali; this would be 0.05 gr. more than the number to be deduced from the nitrate absorbed; but we should attribute this excess to the alkali which might come from the vegetable ashes added to the sand from the commencement of the experiment.

We have seen that according to the nitrate acquired during the vegetation, the plant should have absorbed 0.8026 gr. of nitrate. As 1.110 gr. were used, 0.3075 gr. should remain in the soil. A particular investigation has shown that the sand should contain 0.34 gr. of saline matters very rich in nitrate of potassa.

Notwithstanding the differences which I have shown between the calculated numbers and those given directly, I think we may still consider that the following results may be fairly drawn.

1st.—The nitrogen of the nitrate is absorbed by the plant.

2nd.—For each equivalent of nitrogen assimilated, the helianthus appears to have fixed in its organism, 1 eq. of potassa.

3rd.—Almost the whole of the nitrogen not absorbed by the plant is found in the soil.

4th.—The action of nitrate of potassa, evident from the commencement of the vegetation, is manifested without the necessity for any addition of putrescible organic matter to the soil.

What occurs, when the nitrate has penetrated the plant? Is its nitrogen transformed into ammonia, before entering into the constitution of the vegetable albumen, according to the reaction mentioned by M. Kuhlmann? This is a question which my experiments cannot answer.

(To be continued.)

PHYSIOLOGICAL & PATHOLOGICAL CHEMISTRY.

RESEARCHES *on the* COMPOSITION *of* MUSCLES *in the* SERIES *of* ANIMALS.

By MM. A. VALENCIENNES and FREMY.

THE memoirs which we have published on the composition of eggs had already shown us that a comparative study of the similar parts of organisation, comprising the different classes of the animal kingdom, was always of great chemical and zoological interest. Passing in review, indeed, the eggs of the principal animals, we noticed in their composition fundamental differences for which zoology must henceforward account, and, besides, we have given the general characters

of a new class of organic substances designated by our name of *vitel-line bodies*, which chemistry and physiology can no longer confound with *albuminous substances*.

Profiting by an association which enables us to enter upon questions which spring from zoology and chemistry, we have proposed to extend to muscular fibre the investigations which we originally undertook with respect to eggs; namely, to demonstrate by a comparative study the differences which the muscles present in their chemical composition.

A general examination undertaken on all the animal series should give us at once very accurate notions as to the nature of the proximate principles which are found in the muscular fibre, and as to the analytical processes by which we should be enabled to isolate them.

This conjoint study has enabled us to establish several important facts, which we set forth in this first communication.

The muscular fibre of vertebrate animals which we first examined, was always separated with the greatest care, by anatomical means, from the white aponeurotic or tendinous fibres, from the nervous filaments, from the principal blood-vessels, and from the fat which it contains in considerable quantity.

In analysing the muscles of vertebrata, the proximate principles presented in the first place is *creatine*, the important discovery of which is due, as is known, to M. Chevreul.

Imosic acid and *creatinine*, the characters of which have been so clearly given by Liebig, come next.

In this part of our researches we could only confirm the statements of the illustrious savants just named. We may mention, however, that creatinine appeared to us much more abundant in the animal economy than is generally supposed; we proved its presence in the muscular fibre of almost all the vertebrata; it is often found in the free state, and is then indicated by a very evident alkaline reaction; we have also often met with it in combination with phosphoric acid.

The body which gives acidity to the muscles of all the vertebrata next attracted our attention; it appeared to us interesting to isolate and analyse this principle.

From our researches in this respect it resulted, that if, in some cases, the acidity of the muscles is due to lactic acid, the body which renders muscular fibre powerfully acid is ordinarily the acid phosphate of potassa, which, according to our analyses, has the formula, $KO, 2HO, PhO^5$.

We have extracted this salt in the crystallised state by treating the muscles with weak alcohol, and evaporating the liquor to a syrupy consistence.

In determining the proportion of this salt in the muscles of different animals, we ascertained that it appears to be connected in some measure with the formation of the osseous system; we have, indeed, always found this salt in abundance in animals whose bones are highly developed, and in very small quantity in articulate animals or in mollusca. The part which this salt may play in the formation of

bones will be understood, for we have proved, by direct experiment, that in reacting on carbonate of lime, the acid phosphate of potassa, extracted from the muscles, is capable of giving rise to the basic phosphate of lime, which, as is known, enters so largely into the composition of the osseous substance.

This acid phosphate of potassa is not, perhaps, without its influence on the production of a phosphuretted fatty matter which exists in the muscles, and which will be treated of farther on; we think, therefore, that it is in all respects worthy of the attention of physiologists.

The muscles of the vertebrata are impregnated with a considerable quantity of fatty bodies formed of various proportions of oleine, margarine, and stearine. Besides these neutral fatty bodies, we constantly find another, which differs from fatty matters properly so called by the whole of its properties, and which presents a certain analogy with the cerebral fat.

We have made a very complete study of this interesting matter.

We extract it with facility, by treating the muscles with weak alcohol, which dissolves it without acting on the other fatty bodies.

This liquid, submitted to evaporation, gives a viscid substance, of an amber color, which dissolves incompletely in water; treated with sulphuric acid it decomposes like a soap, giving sulphate of soda and an acid which is heavier than water. This acid is nitrogenous and phosphuretted; when submitted to analysis it presented exactly the composition of the body which one of us extracted from cerebral fat and to which he gave the name of oleophosphoric acid. Thus the phosphorous fat existing in muscles is identical with that found in great abundance in the brain, and is produced, like the latter, by the combination of soda with oleophosphoric acid. This substance is found, it may now be said, in almost every part of the animal organisation: we have ascertained that the proportion of it contained in the muscular tissue increases with the age of the animal, and that it likewise varies in the various species of vertebrata.

Thus fishes with white light flesh, such as the whiting and flounder, contain but a small quantity; whereas those fishes whose flesh is compact and of a distinct flavor, the digestion of which is difficult, such as the mackerel, the herring, the trout, and especially the salmon, contain considerable quantities, moreover, it is this phosphuretted body which, being incompletely decomposed by the action of heat, communicates to fried fish their peculiar taste.

When seeking this substance in the muscles of fish, we have been naturally led to study the red matter which colors the muscles of the salmon and which in trout and some other fish produces the salmon tinge. The remarkable change of color perceived in the muscles of some fish is connected with the phenomenon of reproduction. Thus the salmon is always red at all times of the year, but the color is sensibly paler at the time of spawning. This decoloration is more evident in trouts; indeed, it is well known that at that time the flesh of this fish is quite colorless.

As each individual does not spawn at the same moment, and as the

females remains longer salmonised than the males and assume a deeper tint, it will be understood why in the same water we catch white and salmon trout.

These remarks likewise show that the salmon trout is not a cross between the trout and salmon; the fecundation of one of these fishes by the other appears difficult of comprehension, for the salmon spawns in July and August, whereas the trout spawns in December.

The coloring matter of the muscles of the salmon attracted the attention of Sir Humphry Davy; we find in one of that eminent chemist's works, *The Salmonia*, that the flesh of the salmon may be completely decolorized by ether.

Hitherto this coloring matter has not been isolated; we wished to fill this vacuum. The results of our investigations are, that the coloring matter of the salmon is of a fatty nature, that it presents the characters of a weak acid which we have named *salmonic acid*, and that it is found in solution in a neutral oil.

To separate the salmonic acid we used the following method;—the red oil, which is readily extracted from the muscles of salmon by pressure, is agitated without heat with alcohol which has been rendered slightly ammoniacal; the oil is then completely decolorized, and abandons its coloring matter to the alcohol, from which the ammoniacal salts is extracted with an acid.

The acid thus obtained is viscid, red, and presents all the characters of a fatty acid; that obtained from the muscles of the salmon trout is identical with the acid existing in the muscles of the salmon.

We have found it in considerable quantities, and mixed with oleophosphoric acid in the eggs of salmon, which accounts to a certain point, for the decoloration and loss of flavor perceived in salmon during the spawning season.

The *Salmo hamatus* (Val.) does not contain so much salmonic and oleophosphoric acids as the common salmon (*Salmo salmo*) (Val.); the muscles of even the nearest connected species of fish may consequently have very evident differences in composition.

It was interesting to compare the muscles of the crustacea with those of fishes.

To operate upon the muscular fibre of crustacea, pure and unmixed with other organs, we took the mass of muscular fibres of the tail, taking care to remove the extremity of the intestinal canal and the nervous cord which accompanies it.

The muscles, thus prepared, were subjected to the action of various solvents, and especially to alcohol and ether. They appeared to us more simple in their composition than those of the mammifera, and presented a certain analogy to the muscles of fishes.

Thus the acid phosphate of potassa, which is found in such abundance in the muscles of the mammifera, is almost entirely wanting in the crustacea; the oleophosphoric acid existing in it, on the contrary, in as large a proportion as in the muscles of fishes. We also extracted creatinine from the muscles of several species of crustacea.

To finish this general study of the muscles of various animals, we

still had to examine the muscles of the mollusca, which, in their analysis showed us a very remarkable and quite unexpected fact.

So as to render these analytical results comparable with those which we had obtained with the other animals, we took the greatest care in the preparation of the muscular tissue of the mollusca intended for our experiments. Thus, when operating on the great muscle of the mantle of the cephalopoda, after removing the bone of the internal shell and the plume of the arms, we set aside all the membranes which line the cavity containing the secretions and removed the cartilages which guide, through the corresponding tubercles of the body, the movements of these great muscles. Among the acephala we only took the great adductors of the valves; in one word, avoiding the products of secretion and those organs of very complex composition which are so abundant in these animals which are too often called by mistake, *simple*, we analysed the pure muscular fibre in the mollusca of the classes cephalopoda and acephala. This delicate preparation had a great influence on the clearness of the analytical results which we are now about to report.

We must first observe that the muscles of the mollusca presented a more simple composition than the vertebrated animals; they contain only just appreciable quantities of acid phosphate of potassa, oleophosphoric acid, creatine and creatinine; these proximate principles are replaced by a crystalline matter which we must especially mention. The crystallised body of which we speak may be removed with as much ease from oysters as from the cuttle fish; it may be said to characterise the muscles of these animals.

It is much more soluble in boiling than in cold water; insoluble in alcohol and ether; it combines neither with acids nor bases; it resists the action of nitric acid and aqua regia. When subjected to heat it gives all the products which result from the decomposition of nitrogenous organic substances, and, moreover, disengages sulphurous acid, sulphite and sulphate of ammonia.

The presence of sulphur in the crystalline matter of the Mollusca was confirmed by the elementary analysis of which the following were the results:—

C =	19.5
H =	5.9
N =	10.5
S =	24.0
O =	40.1
	100.0

These results, and the whole characteristics which we have just mentioned, demonstrate that the substance of the molusca is identical with a very remarkable matter discovered by Gmelin in the bile of vertebrata, *taurine*.

To give greater certainty to this interesting fact, we requested M. de Senarmont to determine the crystalline form of the body which we

had obtained from the molusca; this crystallographic determination likewise confirmed the identity of the taurine produced from bile with that existing in the muscles of oysters and cuttle fish.

The presence, in the muscles of the Mollusca, of a substance containing about 25 per cent of sulphur, and which had hitherto only been found in bile, is a physiological fact whose importance must be evident to all; it appears to us likely, by calling attention to taurine, to modify the opinions hitherto expressed as to the part in physiology played by this interesting substance.

Taurine, by the distinctness of its crystalline forms, may be compared to urea, and presents, as well in a chemical as in a physiological point of view, some analogy with this base with an animal origin.

It has been produced artificially, like urea; we know that, according to M. Strecker, isethionate of ammonia, subjected to the action of heat, produces taurine. This substance had until then been considered to result from the decomposition of a sulphuretted acid contained in the bile, and, in comparing it to urea, it had been looked upon in the organism as a substance of elimination.

We think that the results mentioned in our Memoir will modify these opinions and demonstrate that taurine does not always take its rise in the liver, and is perhaps much more abundant in the animal organisation than has hitherto been supposed.

Such are the principal facts which we desired to present to the Academy.

Although in this first work we have only examined a part of the proximate principles existing in the muscles of animals, and although our analyses have only been made on a small number of species belonging to the different groups of the animal series, we find, confirmed, with respect to the muscles, one general fact of great importance which we mentioned in our Memoir upon eggs; it is, that chemical analysis, confirmed, in some respects, the principles which have served as the basis of zoological classification, ascertaining the existence of different bodies, in animals who likewise exhibit fundamental differences in their organisation.

Comptes Rendus, No. 19, November 5th, 1855.

An EXPERIMENTAL INQUIRY into the NATURE of the METAMORPHOSIS of SACCHARINE MATTER, as a NORMAL PROCESS of the ANIMAL ECONOMY.

By DR. PAVY.

THE author begins by observing, that the saccharine matter met with in the animal economy is derived from two sources—from the vegetable kingdom, and from the liver of the animal itself; in each case being poured into the general circulation through the hepatic veins. The liver not only enjoys the power of forming sugar, but it likewise exerts (as shown by the experiments of Bernard) some modifying

influence over that which is traversing its capillaries and which has been absorbed from the food, by which it is transformed from *vegetable* into *animal* sugar, and thus rendered more apt for serving in the processes of animal life.

The sugar poured into the general circulation through the hepatic veins is conveyed to the capillaries of the lungs, where it in great part disappears, but never entirely so, according to very numerous analyses which the author has made on this subject. If the blood be traced onwards from the arteries through the systemic capillaries into the veins, the small amount of sugar which impregnates arterial blood will be found to be still undergoing a process of destruction; and what appears exceedingly interesting, this process of destruction is not carried on with equal activity in the different parts of the system at large. In the capillaries of the chylo-poietic viscera, the destruction is so complete, that the blood in the portal vein may be entirely free from saccharine principle, when the blood returning from other parts, as that contained in the femoral or jugular veins, remains slightly impregnated. This curious fact has a bearing that will be presently adverted to, with reference to the views to be advanced concerning the nature of the metamorphosis of sugar in the animal economy.

The *principal* seat of destruction of saccharine matter in the animal system being located in the respiratory organs, seems at first sight to support the theory of Liebig—that sugar is one of those substances which undergoes a process of combustion, by its direct combination with oxygen, and its resolution into water and carbonic acid. Some experiments on the temporary obstruction of the respiration, and the examination of arterial blood before and after the operation, led the author to call in question this view, as he observed that notwithstanding the supply of oxygen was cut off to such an extent as almost to occasion death, yet a considerable destruction of sugar took place in the lungs. This, coupled with the fact that a disappearance of sugar takes place in the systemic capillaries, and unequally so in different portions of them, induced him to push his investigations, and see if there might not be some other cause in operation in the living animal to effect the normal destruction of sugar, besides the direct chemical action of the oxygen absorbed in respiration. The results of these investigations, which were first directed towards the changes produced in blood normally containing sugar, injected through the capillaries of lungs removed from the animal, and artificially inflated with atmospheric air or oxygen gas, have induced the author to refer the metamorphosis of sugar in the animal economy, to a process which is perfectly consistent and analogous with the well-known chemical bearings of this substance apart from the animal system.

In experiments which the author has now several times repeated, he injected blood removed from the right side of the heart of an animal—and therefore normally containing sugar—through the capillaries of the artificially inflated lungs of another; and found that as long as the blood retains its fibrine, there is as much destruction of its sugar

as would take place in the living animal ; but that where the fibrine has been separated from the serum and corpuscles, the sugar ceases to be influenced by the presence of oxygen, or ceases to disappear during this process of artificial respiration. It would hence appear, that something besides mere contact with oxygen is requisite for the destruction of sugar. But in other experiments, he has found that oxygen is nevertheless a necessary agent concerned in the process of transformation observed during the arterialization of the blood that has not undergone spontaneous coagulation. It would therefore seem, in fact, that oxygen acts secondarily on the sugar through the medium of the fibrinous constituent of the blood :—that it exerts some changes upon this nitrogenous principle, which are capable of inducing the metamorphosis of sugar.

If we look to the ordinary chemical bearings of saccharine matter apart from the animal system, we find that a nitrogenous substance undergoing the molecular changes of decomposition, placed in contact with sugar, readily excites a process of fermentation, and converts it by a mere alteration of the grouping of its elements into another substance, one atom of sugar ($C^{12} H^{12} O^{12}$) being resolved into two atoms of lactic acid ($C^6 H^6 O^6$). We also find that sugar is not susceptible of oxidation except under the influence of strong chemical reagents. Chemical analogy, therefore, would lead us to look upon the secondary action of oxygen as the more probable process of physiological destruction ; especially when we take into consideration, that nowhere do we meet with such a constant series of molecular changes taking place as amongst the nitrogenous constituents of a living animal. In the above-mentioned experiment of injecting fibrinated and defibrinated blood through an artificially inflated lung, when the blood is capable of undergoing the molecular changes of assimilation on contact with oxygen as in the living animal, the sugar in great part disappears, but so soon as the fibrine is separated by spontaneous coagulation, and the blood has thus lost its vital characteristics, oxygen is no longer capable of exerting any metamorphosing influence on its saccharine ingredients.

If the molecular changes occurring during the decomposition of a nitrogenous substance be capable of converting sugar into lactic acid, why should not the molecular changes occurring during the building-up or elaboration of this same nitrogenized compound effect the same? Indeed, we have seen that the process of destruction is carried on to a certain extent in the systemic capillaries, and more especially in those of the chylo-poietic viscera, where the molecular changes of nutrition are also correspondingly carried on with greater activity than elsewhere. So that analogy and experiment would tend to show that the physiological destruction of sugar is owing to a process similar to fermentation induced by the molecular changes occurring in the nitrogenized constituents of the animal during life ; and, in accordance with this, we find lactic acid present in the system, and largely separated from arterial blood by the muscular tissue, and the secreting follicles of the stomach.

As regards the lactic acid fermentation, it is well known that the presence of an alkali favors, whilst that of an acid retards the process. In two experiments on animals, the author injected carbonate of soda and phosphoric acid into the circulating current, and observed in the case of the latter that sugar immediately accumulated in the blood.

The preceding observations refer more especially to the changes that take place in the saccharine ingredient of the blood during life; and the author next proceeds to notice some interesting phenomena observable during the decomposition, and even the spontaneous coagulation of blood containing sugar.

If the blood of an animal normally impregnated with sugar be placed aside, and allowed to undergo spontaneous coagulation, on examining separately the serum and clot on the following day it will be found, that although the serum may be largely saturated with sugar, the clot is entirely, or almost entirely, destitute of it. Now, as the clot is moist and remains to a certain extent infiltrated with the serum from which it has partially separated, it would appear that even the molecular changes arising from the spontaneous coagulation of the blood are sufficient to effect the destruction of normal animal sugar; and this conclusion is strengthened by the fact, that in diabetic blood (the sugar of which, as would appear from other considerations also, is not so susceptible of metamorphosis as the healthy variety) the sugar does not disappear to a similar extent in the clot.

Under the changes of the decomposition of blood, normal animal glucose is very readily metamorphosed. The rapidity of the metamorphosis depends on the activity of the decomposition of the animal substances present, and when the destruction of the sugar is complete the blood has assumed an acid reaction.

This acid reaction of decomposing blood is only observable in that which was previously pretty largely impregnated with sugar. It appears to be owing to the formation of lactic acid. Certainly, it cannot be due to carbonic acid, for the reaction remains after exposure to a boiling temperature.

The disappearance of sugar in the manner just pointed out does not depend on the oxygen of the air, except in so far as this agent is concerned in exciting the decomposition of the nitrogenous constituents of the blood; for the sugar disappears as rapidly when there is a small, as when there is a large amount of surface exposed to the air. But if the air be carefully and completely excluded, no signs of decomposition of the animal parts of the blood are to be observed, and under these circumstances the sugar also remains. The disappearance of sugar is more rapid where the fibrine and corpuscles are present, than when the serum is exposed alone; and in accordance with this, the blood in the one case undergoes decomposition much sooner than in the other—a fact easily intelligible from the greater amount of nitrogenous ingredients present.

If blood normally impregnated with saccharine matter be placed aside until signs of incipient decomposition are observed, and the sugar is beginning to disappear, exposure to a current of oxygen rapidly

completes the total disappearance of the saccharine constituent. In this observation we have a further illustration of the analogy that appears to exist, in the nature of the metamorphosis of sugar as a physiological process, and that which takes place chemically under the influence of a nitrogenous compound, whose elementary particles are in a state of molecular transition. During life, the higher organic constituents of the blood are capable of undergoing the changes of assimilation on exposure to contact with oxygen, and there is a considerable destruction of sugar effected; for a short period after death these nitrogenous constituents remain stationary and uninfluenced by oxygen, and with this, there is a corresponding suspension of the transformation of sugar; but, finally, the animal matter of the blood on contact with oxygen, especially during a warm temperature, assumes a state of decomposition, the molecular changes of which again excite the destruction or metamorphosis of saccharine matter.

The sugar *disappears far less rapidly* from diabetic blood under the influence of exposure to the atmosphere, than from healthy right-ventricular blood. From these, and a few other observations which he has yet been able to make on the blood in Diabetes Mellitus, the author, were he to hazard an opinion on the nature of that obscure disease, would be disposed to say that there appears to be a modification of sugar produced by the liver, which is not susceptible of undergoing the normal process of destruction in the animal system, and which, therefore, accumulating in the blood, is eliminated by the kidneys. The experiments of Bernard have shown that vegetable glucose (grape-sugar) is not susceptible to destruction in the process of animal life, unless converted into animal glucose by the agency of the liver. Diabetic sugar would therefore seem to bear resemblance in its physiological relations to vegetable, rather than to animal glucose.

Proceedings of the Royal Society, vol. vii., No. 13.

On the SEARCH for SUGAR in the BLOOD of the VENA PORTA.

By M. C. G. LEHMANN.

I HAVE already mentioned that during the digestion of meat, the blood of the *vena porta* which enters the liver does not contain sugar. As some contradictory opinions have been expressed on this subject, it appeared to me necessary to fix the method of investigation which should be pursued in entering into this question of physiological chemistry. It was necessary, 1st, to determine the chemical method by means of which we could ascertain in an accurate and unquestionable manner, the presence or absence of sugar in the blood of the *vena porta*; 2nd, to determine the physiological process by which the blood could be procured from the *vena porta* in sufficient quantity for analysis, operating at the same time, in such a manner, that nothing should be obtained, but the blood which circulates normally in that vessel.

I. The chemical process which I have used is by no means new; I

published it in 1840, in the first edition of my *Traité de Chimie Physiologique*, and I have since used it in my investigations as to the composition of the blood of the vena porta and hepatic veins of horses. This method is based on the possibility of the complete separation of the sugar by precipitation. It is well known that glucose, cane sugar, and lactae forms, compound with potassa which is insoluble in alcohol. For this reason in searching for sugar in the blood of the vena porta or in any other blood I operate in the following manner. I treat the blood with alcohol and after the evaporation of the alcoholic solution, I obtain an extract or residue which I take up again with very strong alcohol, after which I add an alcoholic solution of caustic potassa to this alcoholic solution. The saccharate of potassa is then precipitated forming a deliquescent mass, very soluble in water. The aqueous solution of this compound always gives an indubitable reaction with caustic potassa and sulphate of copper. It is true that the alcoholic solution of sugar, when treated with potassa sometimes precipitates other matters, such as chloride of potassium, a little carbonate of potassa and organic matter; but I never observed that it interfered with the reaction. To another portion of the solution of saccharate of potassa, may be added tartaric acid until the liquor shews a slight acid reaction, and fermentation obtained by putting the solution in contact with beer yeast; for I have never found that any substance was precipitated with the sugar which prevented the alcoholic fermentation. I have, by this means, ascertained the presence of sugar in human urine in which 1-100,000 had been previously introduced. I have also discovered glucose in liquids in which the potassio-cupreous liquors or beer yeast had given but dubious results, for example in the urine of arthritic or tuberculous patients, &c. Finally, I have ascertained that, as in the albumen of bird's eggs, so also there is sugar in the ovaries of the mammifera, and probably in all venous blood; but that neither saliva nor bile contains any.

II. As to the physiological conditions in which the blood must be obtained from the vena porta, M. Bernard fixed them long ago. But authors have neglected them, although they are indispensable, if we wish to act irreproachably and procure for analysis blood belonging only to the vena porta. If we take from a living dog, even of large size, seven hundred or even three or four hundred grammes of blood at once from the *vena porta*, we place ourselves in a bad position for experiment and obtain blood which is unsuitable, as is clearly proved by the following considerations. We know that the pressure on the blood in a vein is diminished when the blood flows from an opening made in the vein; now it results that not only does the blood in the communicating vessels, whose pressure has become relatively greater, flow in great quantity towards the opening, but even the liquids contained in the parenchyma of the organs is diffused, in obedience to the law of the diffusion of liquids, into the vessel the pressure of which has been diminished. Moreover, M. Ed. Weber and I have found that the total quantity of blood contained in an adult man does not

exceed one tenth part of the weight of the body ; and lately MM. Bischoff and Welcker have said that in men and the mammifera generally, the mass of the blood forms the thirteenth part of the weight of the body. Now if we remove from a dog weighing twenty-four kilogrammes (which would be a very large one) seven hundred or even three or four hundred grammes of blood from the *vena porta* it is impossible to imagine that they have the pure blood of that vein, for it would be very unlikely that the fourth part of the blood of the body is contained in the system of the *vena porta*.

To avoid, as much as possible, the inconveniences which I have just mentioned, I never bleed a living dog from the *vena porta*, but always kill them first by a blow on the head, then, according to M. Bernard's method, I place a ligature round the *vena porta* at its entrance into the liver. Then I completely open the abdominal cavity and introduce a glass tube bent twice at right angles into a small opening in the *vena porta*. Having fixed this tube with a ligature, I permit the blood to flow from the vein, which has hitherto been compressed between two fingers, into a small glass flask. The heart still makes some contractions, and the access of the air, accelerating the peristaltic movements of the intestines, causes a great quantity of uncoagulated blood to flow. I have thus collected thirty-five to eighty grammes of blood from large dogs and I do not think that this quantity is too great to be the amount circulating in the *vena porta* during the life of the animal.

I have thus experimented upon sixteen dogs, who, after fasting for twenty-four hours, have had a meal of as much horseflesh as they liked and have been killed from three to six hours after the repast. In these sixteen experiments I never found a trace of glucose in the blood of the *vena porta*.

But it may be said that notwithstanding the accuracy of the chemical method which I employed, the quantity of blood collected (from thirty-five to eighty grs), was insufficient to discover minute traces of glucose ; I therefore performed the following two experiments ; from three dogs fed on meat I collected and united the blood obtained from the *vena porta*, making in all 217·5 grs. of blood ; from three other dogs I obtained in the same manner 192·7 grs. of blood ; but notwithstanding this considerable quantity of blood I could not find a trace of glucose in either case in the *vena porta*.

To convince myself that when glucose is found in the blood of the *vena porta*, it is because too much has been obtained from living dogs, I removed 351 grs. of blood from the *vena porta* of a dog weighing 13 kilogrammes, and from another which weighed 11·5 kilogrammes, I removed 211 grs., and from a third weighing 14·5 kilogrammes, I removed 263 grs., and I must say that in these three cases I ascertained beyond a doubt the presence of glucose.

The conclusions which appear to me evident from these experiments are that ; Ist., when too much blood is drawn from the *vena porta*, we do not obtain suitable blood, nor such as circulates normally in the

vessel during life; 2nd., that when we place ourselves in such conditions as to obtain only the pure blood of the *vena porta*, no glucose is found in it during the digestion of meat.

III. But if, during the digestion of meat the *vena porta* entering into the liver does not contain sugar, might it not contain a matter easily convertible into sugar (a glucoside)? Having long since asked myself this question, I digested the alcoholic extract or the aqueous extract of the blood of the *vena porta* with diastase or synaptase, then I boiled it with a few drops of sulphuric or nitric acid. But I never succeeded in obtaining any fermentable substance. During the digestion of the meat there was not formed, either in the stomach or small intestine any glucogenic substance, (glucoside). I have frequently repeated the above mentioned experiments with the different extracts of the matter found in the stomach and small intestine of dogs fed on meat, and in these cases I have as uniformly been disappointed.

The idea has been mentioned that the blood of the *vena porta* contains a matter which prevents alcoholic fermentation. To ascertain the accuracy of this opinion I have added small quantities of sugar to the alcoholic extract of the blood of the *vena porta* and I must say that I have always found that the phenomena of alcoholic fermentation appeared in the ordinary manner.

We must then admit that, during the digestion of meat there is no antiseptic matter in the blood of the *vena porta*, and on the other hand that no trace of glucose is found by the most accurate reagents. So that, if there has been found in the blood of the *vena porta* any substance rendered fermentable by means of sulphuric acid, it must not be supposed that glucose is hidden in the blood of the *vena porta* by a foreign matter, but must absolutely, on the contrary, conclude that this matter is a non-fermentable sugar, or rather a copulate sugar, a glucoside, which is decomposed by the action of sulphuric acid. But we must add that should any one succeed in discovering such a glucoside in the blood of the *vena porta*, far from disproving M. Bernard's glucogenic theory, this fact would fully confirm it, because we should be forced to admit that it is in the liver that this matter is decomposed during life.

Comptes Rendus, No. 17, October 22nd, 1855.

REMARKS on M. LEHMANN'S COMMUNICATION.

By M. CL. BERNARD.

THE determination of the question of the existence or non-existence of sugar in the *vena porta* of a carnivorous animal during the digestion of meat is of great importance with respect to the glucogenic function of the liver; for, to conclude that the sugar always found in considerable proportion in the hepatic tissue, is produced by a peculiar secretion of the liver, we must assure ourselves, above all, that the blood of the *vena porta* entering this organ does not bring to it any saccharine matter.

We have nothing to add to the exact and decisive chemical and physiological experiments of M. Lehmann. We shall merely remark, that after this long discussion nothing is changed in the proposition on which we founded the theory of the glucogenic function of the liver. It has now been established, as we at first announced, that in a carnivorous animal the blood which enters the liver does not contain sugar, whereas that which issues from it contains appreciable quantities, whence the necessity of admitting that the saccharine substance is produced in the liver.

Still we must acknowledge that the discussion, by calling the attention of chemists and physiologists freshly to the question, has led them to determine definitively the conditions of the chemical and physiological investigation, and has rendered all dispute henceforth impossible as to the existence of the glucogenic function of the liver; the mechanism of it has still to be more carefully studied, but the physiological reality of it is proved experimentally in the most positive manner.

Comptes Rendus, No. 17, October 22nd, 1855.

REMARKS on M. LEHMANN'S MEMOIR *Relative to the Search for SUGAR in the BLOOD of the VENA PORTA.* By M. L. FIGUIER.

M. LEHMANN, of Leipzig, has addressed to the Academy of Sciences a Memoir on the presence of sugar in the blood of the *vena porta*. The credit justly attaching to the labors of this chemist imposes on me the necessity of presenting to the Academy some remarks on the conclusions which must be drawn from his researches.

The general result of M. Lehmann's experiments is, that when we employ, for detecting sugar in the blood of the *vena porta* of a carnivorous animal during the digestion of meat, very small quantities of blood (35 to 80 grammes), we find no sugar, but that in operating on larger quantities (211 to 351 grammes) the presence of sugar is established beyond doubt. M. Lehmann explains this result by stating that when we take from a dog, one of large size, more than 35 to 80 grammes of blood of the *vena porta*, we no longer operate on the pure blood of that vessel. I think this may be naturally explained by saying, that if we find no sugar with 35 or 80 grammes of blood, it is simply because this quantity is too small. In operating with 35 grammes of blood taken from the arm, the presence of sugar could not be put in evidence with all its characters, for chemical analysis has necessarily limits beyond which we cannot rely on its indications.

This is not the only remark which I desire to present on the subject of the Memoir of the learned chemist of Leipzig.

When we propose to control and verify the assertions of an observer, the first care should be to repeat his experiments in conformity with the process which he has followed. The process which I employ for the detection of sugar in the blood of animals has received, if I may

be permitted to say so, the approbation of all chemists. How is it, then, that in proposing to repeat any experiments relative to the blood of the *vena porta*, M. Lehmann has not thought proper to follow or even to mention it?

For the method employed by me, M. Lehmann has substituted one which differs from it essentially. To detect sugar this chemist treats blood with three times its bulk of alcohol, evaporates to dryness, and re-dissolves the residue in alcohol. This alcoholic solution is then treated with a caustic potassa ley. The sugar, if it exists in this liquid, should form with potassa an insoluble compound and deposit, after a few hours, at the bottom of the vessel, under the form a soft, gelatinous precipitate. This precipitate being collected, it is re-dissolved in water, and we detect in this solution the characters of glucose by means of the cupro-potassic test and fermentation.

It is not for me to judge of the accuracy and value of this process; I will therefore restrict myself to one general reflection. Of all the methods which consist in determining the presence of sugar in the blood, that in which the action of caustic alkali is made to intervene, would be, in my opinion, the last to be made use of. No one is ignorant that the alkalis in the free state promptly attack and destroy glucose and the sugars of the secondary species, giving rise to various products of reduction. The brown coloration obtained by means of heat and the action of a few drops of caustic potassa, which coloration results from the decomposition of the sugar, is the character which is relied on daily in hospitals and laboratories for proving the presence of sugar in liquids of animal origin. It is therefore not very rational when we have to seek for very small proportions of sugar in small quantities of blood, to put the organic matters in which this investigation has to be made, in contact with caustic potassa, and to leave these two matters in contact for several hours. I may add that this combination of glucose with potassa, that these *alkaline glucosates*, the precipitation of which is the basis of this process of investigation, are as yet very little known to chemists. All that can be said of them is, that these three combinations, which are easily produced with cane sugar, are formed only with very great difficulty with glucose or the sugars of the secondary kind, and that they are destroyed almost immediately after their formation when they are dissolved in water. Owing to these facts, it appears to me not very accurate, I repeat, to base a method of detecting sugar in organic liquids on the employment of a caustic alkali. The principle advantage, and that which constitutes, if I may say so, the merit of the process which I have proposed for isolating the sugar contained in normal blood, is that during the operation the presence of every alkali is avoided, and that we operate on an acid liquor.

I may remark, also, that every thing shows that the saccharine principle contained in the blood of the *vena porta*, a product which has just been formed in consequence of the decomposition of the nitrogenous alimentary matter, cannot be compared chemically with glucose,

which results from the digestion of feculents with the sugar of fruits, diabetic sugar, or any other type or congener of the sugar with which it may be wished to compare it. It would not therefore be impossible that grape sugar, diabetic sugar, and the sugar of the liver, giving rise, in combining with potassa, to a compound insoluble in alcohol, the sugar contained in the blood of the *vena porta* might form with potassa a compound endowed with the same properties, that is to say, insoluble; like it, in alcohol. Thus the process which is based on the formation of this insoluble compound of potassa would not be capable of indicating the presence of this saccharine principle in the blood of the *vena porta*, and would be, consequently, as regards their detection, of no value.

It is therefore not surprising that, employing a process the accuracy of which does not appear to be very great, when applied to the blood of the *vena porta*, M. Lehmann has not succeeded in detecting the presence of glucose when he operated only on such small quantities of blood as those which he used in his experiments. He has been more fortunate in operating on the quantities of blood which I employed in my experiments, which shows beyond doubt that his process errs in point of delicacy.

M. Lehmann says, in concluding his Memoir, that my experiments do but confirm the theory of the glucogenic function of the liver. "Should any one succeed," says M. Lehmann, "in discovering such a *glucoside* in the blood of the *vena porta*, far from disproving M. Bernard's glucogenic theory, this fact would fully confirm it, because we should be forced to admit that it is in the liver that this matter is decomposed during life." This reasoning appears to me inadmissible. If it is established that, there exists in the blood of the *vena porta*, in the conditions which we are studying, and during digestion, a substance capable of being easily converted into sugar, a sort of copulate sugar, the glucogenic function could not be any longer sustained. The partisans of this theory assimilate the secretion of the sugar to all the secretions properly so called, which are accomplished in the system, to the secretion of bile, saliva, tears, &c. Now, if the liver receives during digestion a matter from the pancreatic fluid capable of being transformed into sugar by a slight chemical modification, this organ is no longer a true secreting organ; it is limited to effecting a simple modification in a product which comes to it from the digestive tube, and which only requires a feeble chemical influence to convert it into glucose. It is no more an organ secreting sugar than the intestine itself is an organ secreting that product when it converts into glucose the fecula contained in our food, no more than the stomach secretes albuminose, when it transforms, by the action of the gastric juice, the nitrogenous aliments into that product.

Comptes Rendus.

PHOTOGRAPHY.**MOIST and DRY COLLODION.**

By M. DUPUIS.

I PREPARE my photographic collodion as follows:—

Comercial ether	100 gr.
Alcohol at 36°	10 „
Gun cotton	1 „
Iodide of ammonium	1 „

I agitate, and after a few hours repose. I decant and filter through carded cotton. I use it immediately. When not required at once it is better to prepare 100 grammes of collodion without the iodide, and to decant 10 or 20 grammes when wanted, adding then 1 or 2 decigrammes of iodide. When the iodised collodion which has been prepared previously is used, the proofs appear very good, but when dry, they assume a marbled appearance, which is transferred likewise to the positive. This preparation is very sensitive; a portrait may be perfectly taken in four, five, or six seconds.

Iodide of ammonium appears to me the most sensitive of the compounds of iodine, but its composition is very variable in consequence of the volatility of the two component bodies. That of MM. Rousseau in transparent violet crystals is excellent. White iodide of ammonium is likewise successful, but there is some in opaque, brick colored crystals which is very slow. In all these cases it is easy to modify their color and sensitiveness. When placed in a porcelain capsule on a fire, the brick-colored iodide, slightly bruised with a porcelain pestle, disengages first violet vapors of iodine, and then white vapors with the odor of urine. This compound in the meanwhile becomes pulverulent and nearly white; it is put while hot into a dry phial with a ground glass stopper. It will then have acquired the sensitiveness of the best iodides.

I develop the image with pyrogallic acid.

My process for dry collodion is very simple. I make the collodion as follows:—

	gr.
Alcohol at 36°	10·0
Rectified ether at 60°	100·0
Gun cotton	0·8
Iodide of zinc	1·0

I prefer iodide of zinc, although rather slow, because it gives very distinct proofs.

The collodionised plates are immersed in a bath of aceto-nitrate, washed with distilled water and covered while still wet with a very slight varnish of dextrine, prepared by treating ten parts of dextrine *cold* with thirty parts of water, agitating for some minutes, and after several hours' repose decanting the reddish solution which covers the undissolved dextrine through filtering paper.

I leave the varnished plates to dry and keep them from the light; I have used them successfully eight days after. I have never tried them after a longer period. I have obtained a proof in five minutes when waxed paper has required fifteen and albumen twenty five.

The developement of the proof is very easy; I hold the plate as at the commencement of the manipulations, wet it well with distilled water then pour on

Pyrogallic acid	.	.	.	.	.	1 gr.
Distilled water	.	.	.	.	.	300 "
Acetic acid	.	.	.	.	.	10 "

I move this solution over the plate until the greasy appearance produced by the acetic acid disappears, then pour it into a capsule in which I have previously put about 30 drops of aceto-nitrate. This mixture poured over the plate immediately develops the image, and if left on the plate for a short time, gives it every desirable strength. I wash and fix in the ordinary manner; I let it soak for about half an hour in common water, pour a little distilled water on it and dry immediately with heat.

Cosmos, November 23rd., 1855.

PHOTOGRAPHY *on* ALBUMENISED *and* COLLODIONISED GLASS.

By M. F. MARTENS, Photographer to the Emperor of the French.

M. NIEPCE DE SAINT VICTOR, who first showed proposed the use of albumen on glass with the addition of iodide of potassium, has given us an excellent method of obtaining very perfect images. The use of this substance must however be varied according to circumstances, places and temperature. Thus, on putting iodide of potassium only, we should have in very hot, dry weather, crystallisations, at first imperceptible, but very apparent when the layer is coagulated; as I have ascertained as well as M. Regnault and M. Fontaine. These are the points which drive photographers desperate, but if we replace iodide of potassium with iodide of ammonium, all crystallisation is avoided. A little iodine is to be put into a small phial, which is then filled with iodide of ammonium; in a short time the iodine is disengaged and colors the iodide of ammonium.

Preparation of the Glass Plates.—It is necessary to vary the preparation of the glass plates according to the subjects for which they are intended. Thus, for architecture, less iodide will be used, so as to have a thinner layer and more delicacy in the details. If intended for trees, etc., the layer may be thicker and more sensitive, which will give as soft proofs as waxed paper.

To the whites of eight eggs I put 2 grs. of iodide of ammonium, 1 gr. of dextrine, 25 grs. of distilled water and $1\frac{1}{2}$ gr. of grape sugar. These are good proportions for architecture. If for landscapes, I put double or even treble the amount of iodide. The grape sugar and dextrine are

dissolved in hot water, stirring with a glass rod; the iodide is then added, and the whole is poured into the white of egg, which has been previously prepared in a salad bowl. The whole then assumes a deep brown tint, which however soon disappears when the whole is beaten into a snow with a small whisk composed of six or eight goose feathers tied together. The froth having attained such a consistence as not to flow, it is left standing all night and used on the morrow.

Grape sugar blends better with albumen than honey, and is very useful in preventing the layer from cracking in hot, dry weather. It is necessary carefully to avoid drying the plates at the fire, as that renders them liable to crack; it is better to leave them to dry naturally, putting, if in any hurry, a spirit lamp into the closet in which the albumenised plates are placed, but not leaving it in too long. If the weather is damp it is unnecessary to put grape sugar into the albumen. Dextrine gives great tenacity to the layer, and the water renders the whole easier to spread upon the glass; the quantity may be augmented if the weather is hot and dry.

There are different processes to albumenise the glass; for example a pipette and beginning at the upper part and going downwards, as proposed by M. Fortier, or by using a pledget of gutta percha to support the glass, and by pouring the liquid on it, causing it to run off from the four corners. Turning the glass until the layer has become even, it is then placed upon a perfectly level table and thus allowed to dry. This requires a great deal of practice, and there are no secrets to give that, as many people appear to imagine; it likewise requires great care, and especially great cleanliness in all the preparations.

Albumenised glasses may be preserved for any length of time. If we wish to preserve them during a tour it is necessary to wash them carefully when taken out of the nitrate bath. After the exposure, they may likewise be kept for some days before developing the image, always carefully keeping them in the dark.

Collodionised and Albumenised Glasses.—On returning to Lausanne from my journey to Mount Blanc last year, I thought of applying on a collodionised and sensitive glass an albumenised and saccharine layer; I then let it dry. The next day I rendered the glass sensitive; I then obtained an excellent negative proof of the cathedral. I also ascertained that the combination of these two processes might, with some modifications, give good results. I immediately informed several persons at Paris, and on my return, M. L. Chambord, assayer and chemist to the Imperial Mint, tried the process before several people, being myself too busy to continue the experiment.

In fact I did not think much of this combination, because the operation is complicated and expensive. Thus, with a phial of collodion costing 6 fr. I could scarcely cover five of my large glasses, whereas with the white of egg of the same value more than a hundred may be albumenised. Moreover, two silver baths are wanted, one for collodion without acid and the other for albumen.

The glass being collodionised and carefully washed, is covered with a layer of albumen, prepared as above mentioned. This operation requires great care, water must not remain on the glass, the albumen must be poured on one end of the glass and allowed to run off in a small stream; to remove the water, it is allowed to drain, then albumen is again put on, which is run over the whole glass so as to make an even layer and suffered to dry upright.

The layer obtained with the combination of albumenised collodion is much more sensitive than albumen alone, if used within a very few days; because the collodion being covered with albumen dries very slowly and at the same time it prevents the albumen from drying completely.

Great care must be taken to clean the glasses, as otherwise the layer will form patches when the image is developed or will become detached in drying. It is better to use gallic acid for developing the image, as pyrogallic acid often stains the proof; a few drops of a new solution of nitrate must be added, formed of 4 grs. of nitrate, and 4 grs. of acetic acid to each 100 grs. of distilled water, if greater contrasts are wanted in the half lights.

If a sheet of heated copper is placed under the bath, the image will be more rapidly developed.

For fixing, use a bath of hyposulphite of 12 per cent., wash in several waters and dry.

Cosmos, November 30th, 1855.

On a PROCESS for obtaining LITHOGRAPHS by the PHOTOGRAPHIC PROCESS.

PROFESSOR RAMSEY described a process by which Mr. Robert M'Pherson, of Rome, had succeeded in obtaining beautiful photolithographs, specimens of which had been hung up in the Photographic Exhibition in Buchanan Street. The steps of the process are as follows:—1. Bitumen is dissolved in sulphuric ether, and the solution is poured on an ordinary lithographic stone. The ether quickly evaporates, and leaves a thin coating of bitumen spread uniformly over the stone. This coating is sensitive to light, a discovery made originally by Mr. Niepce, of Chalons. 2. A negative on glass or waxed paper, is applied to the sensitive coating of bitumen, and exposed to the full rays of the sun for a period longer or shorter, according to the intensity of the light, and a faint impression on the bitumen is thus obtained. 3. The stone is now placed in a bath of sulphuric ether, which almost instantaneously dissolves the bitumen, which has not been acted upon by light, leaving a delicate picture on the stone, composed of bitumen on which the light has fallen. 4. The stone after being carefully washed, may be at once placed in the hands of the lithographer, who is to treat it in the ordinary manner with gum and acid, after which proofs may be thrown off by the usual process. Prof. Ramsey then

proceeded to state that the above process modified, had been employed with success to etch plates of steel or copper, without the use of the burin:—1. The metal plate is prepared with a coating of bitumen, precisely in the manner noticed above. 2. A positive picture on glass or paper is then applied to the bitumen, and an impression is obtained by exposure to light. 3. The plate is placed in a bath of ether, and the bitumen not acted upon by light is dissolved out. A beautiful negative remains on the plate. 4. The plate is now to be plunged into a galvano-plastic bath, and gilded. The gold adheres to the bare metal, but refuses to attach itself to the bitumen. 5. The bitumen is now removed entirely by the action of spirits and gentle heat. The lines of the negative picture are now represented in bare steel or copper, the rest of the plate being covered by a coating of gold. 6. Nitric acid is now applied as in the common etching process. The acid attacks the lines of the picture formed by the bare metal, but will not bite into the gilded surface. A perfect etching is thus obtained.

TOXICOLOGY.

Two Cases of FATAL POISONING with PHOSPHORUS, COMMUNICATED by DR. REISIG, IMPERIAL and ROYAL DISTRICT PHYSICIAN at VOCKLABRUCK.

As post-mortem examinations in cases of poisoning with phosphorus are rare, I take the opportunity of publishing an abstract of the judicial autopsies of a man and woman (Jacob and Theresia Schobesberger), of whom the woman was poisoned with lucifer matches by the man, and at the end of eight days the man when arrested poisoned himself, probably in the same manner. Both died after an illness of four days. The similarity of the phenomena in the two bodies is striking, although the man took the poison only in small quantity, as the smell of phosphorus in his stomach was but faintly perceptible.

THERESIA SCHOBESBERGER.

External Condition of the Body.

The hair easily extracted, as in poisoning with arsenic. Mucous membrane of the mouth very pale.

Internal Condition of the Body.

a. Cavity of the Abdomen.

1. The outer surface of the stomach reddened; the vessels at the lesser curvature enlarged and distended with dark-brown colored blood. On the posterior surface a roundish black spot,

JACOB SCHOBESBERGER.

External Condition of the Body.

The hair easily detached. The cavity of the mouth pale. The face and chest jaundiced.

Internal Condition of the Body.

a. Cavity of the Abdomen.

1. The same appearances, with the exception of the black spot.

five inches in length and two in breadth.

2. On opening the stomach a strong smell of phosphorus; the mucous membrane of the stomach in its entire extent was of a brownish black color, and covered with a thick mucus; at the cardiac orifice, the fundus, and the lesser curvature, it was studded with numerous streaky dark red spots. The mucous membrane was remarkably soft and macerated. The muscular coat of the stomach was reddened.

3 The mucous membrane of the upper third of the small intestine was in the same state as that of the stomach, but was covered with a thick and light brown mucous mass. There was no phosphoric smell in this part.

4. The liver was of a remarkably whitish yellow color externally, and on section it was exsanguine. The gall-bladder was distended with a large quantity of very dark green bile. The bladder contained urine of a dark-brownish red color.

b. Cavity of the Thorax.

The lungs presented a black appearance, and contained much blood. The heart was soft, pale, and void of blood. In each side of the thorax were contained five ounces of a red sanguineous fluid.

c. Cavity of the Cranium.

Membranes of the brain and cerebral substance exsanguine.

2. On opening the cavity of the stomach a very faint smell of phosphorus. The mucous membrane was slightly reddened, and was in several situations studded with dark-brown spots. It was macerated, and so soft that with the nail it could be easily scraped off from the muscular coat. It was nowhere corroded.

3. The same appearances.

The peritoneum and the mesentery, as well as the abdominal muscles, were everywhere studded with numerous sanguineous extravasations.

4. The liver presented a white color, and was exsanguine. The gall-bladder and urinary bladder were the same as in the other case.

b. Cavity of the Thorax.

The lobes of the lungs were of a very dark red color, full of blood, and soft. The pleura and thoracic muscles were studded with numerous dark red spots of sanguineous extravasation. In each thoracic cavity were four ounces of blood red fluid.

c. Cavity of the Cranium.

Membranes distended with blood. Between the dura mater and arachnoid a thin layer of fluid blood was effused.

OBSERVATION.

The longer the divided muscles and viscera were exposed to the action of the atmospheric air, the more their redness increased to a brick red color.

OBSERVATION.

The same remark is applicable as in the other case, and in instances of arsenical poisoning.

—*Wochenblatt der Zeitschrift der kaiserl. königl. Gesellschaft der Aerzte zu Wien*, 14th May, 1855. Page 313, and *Dublin Quarterly Journal of Medical Science*.

On some SINGULAR NERVOUS AFFECTIONS due to a SLOW POISONING by NICOTINE, INHALED during SMOKING.

SIEBERT describes, in his Memoir "On the Diagnosis of Diseases of the Abdomen," a work which has just issued from the press, the pernicious effects of the use of the cigar. These effects depend on a slow poisoning by nicotine, and constitute serious affections of long duration, the causes and origin of which usually escape the notice of the practitioner, and determine the failure of the various modes of treatment employed.

Berzelius had already shown that cigars contained more nicotine than ordinary cut tobacco. In consequence of the mode of preparation which tobacco cut up for the pipe undergoes, the nicotine in it is already reduced to its minimum of activity. But this is not the case with the leaves destined to be converted into cigars; the latter, in fact, are not subjected to the same preliminary preparation. Accordingly, it is chiefly in consequence of the use of cigars that the affection to which we are directing attention is observed, and which consists in a very obstinate neurosis, slowly developed, under the influence of the continued ingestion of very minute quantities of nicotine. This neurosis takes the form of an irritation of the spine, and produces, according to the point of the spinal marrow principally affected, different eccentric phenomena, such as bronchial spasms, a feeling of suffocation, palpitation of the heart, gastrodynia and vomiting, mesenteric neuralgia, &c. As examples of this slow poisoning, we shall cite the following cases reported by Siebert:—

A very robust man, aged 30, was from 1840 to 1845 liable to nervous attacks of the most varied kind, such as numbness of the fore arms and hands, palpitations, hypogastric oppression, want of appetite, and even vomitings; spasms of the sphincter ani, and nocturnal seminal emissions, followed by great depression. The motor power of the lower extremities was from time to time disturbed; deambulation, as well as ascending a height, became uncertain; vertigo and double vision were superadded. These symptoms, at first attributed by Siebert to hyperemia of the spinal marrow, were combated by cupping, leeching, and purgation, but they only got worse. Preparations of iron always

gave relief, but without producing a complete cure, Siebert then insisted that his patient, who was in the habit of smoking a number of cigars of good quality, should abstain from them for at least four weeks. At the end of this time he felt himself quite another man. To complete his cure, he repaired to the chalybeate waters of Steben, which strengthened him much, and from which he returned completely restored. During the winter of 1845, he was tempted to smoke a cigar, when the symptoms above described immediately returned, and only yielded to the use of iron, continued for four weeks.

The second case was that of a man of cachetic and almost mummified aspect, who consulted Siebert for total loss of appetite. The only time at which his state was at all supportable was after smoking a very strong cigar. He was attacked regularly every afternoon with violent colicky pains, which lasted several hours. Purgatives were tried without success. For years he had tremors and weakness in the extremities, palpitations of the heart, and sometimes vomiting; for some months past he had, in addition, complained of a disagreeable sensation, like a blast, in the lower part of the spinal column, combined with intestinal pains recurring daily, commencing each time in the umbilical region, spreading through the entire abdomen, and becoming concentrated in the back; these pains were intolerable, rending, crushing, but ceased during the night. He was not subject to vomitings at other times, nor was there any derangement of the alvine evacuations. From the time that he gave up the use of cigars the symptoms entirely ceased; but not being able to deny himself the enjoyment of smoking beyond four weeks, he resumed the habit, and the pains returned.

It is not every kind of cigar that produces these effects—those of a fine and narcotic description are generally the most injurious. Neither are all smokers subject to the poisonous effects. We may, however, assert that nervous affections occur more frequently in men, since the cigar has displaced the pipe. It is often very difficult to ascertain the causes and origin of the disease, for enthusiastic smokers deceive both themselves and their physicians; and, what is worse, the symptoms produced by poisoning with nicotine are sometimes quickly dissipated by the use of the cigar, just as those due to opium often yield to a fresh dose of the narcotic.

Strong cigars at first excite the appetite and, after meals, favor stomachic digestion, which circumstance induces the true smoker to fly to his cigar immediately he has swallowed the last morsel. These individuals ought carefully to avoid any derangement of digestion. The appetite and the digestive powers soon diminish, enteric pains become developed, and at the end of a short time constitute true neuralgic paroxysms.

The *Allgemeine Medicinische Central Zeitung*, from which this article is extracted, adds the following note:—"Our colleague, Dr. Ravoth, has verbally informed us, that he has seen a case of poisoning by nicotine in a physician already advanced in life, who smoked much, but the pipe."—*Journal de Médecine de Bruxelles*, and *Dublin Quarterly Journal*.

[We meet very commonly with a similar train of nervous symptoms amongst the lower classes of this country, many of whom smoke common tobacco to excess. And our lamented friend, the late Dr. Graves, was so severely affected with vertigo and other nervous symptoms from smoking a cigar that during the last four or five years of his life, he was compelled to abandon the practice altogether.

Ed.]—*Dublin Quarterly Journal of Medical Science.*

MATERIA MEDICA, PHARMACY, AND THERAPEUTICS.

On the Digestibility of Iodide of Starch.

By DR. JUTTE.

MANY physicians, when prescribing preparations of iodine, forbid the use of amylaceous food; acting upon the theory, that, from the great affinity of iodine to starch, the iodide of starch must be formed, which, as such, would pass from the body *undissolved*, whereby the action of the medicine would be weakened or wholly destroyed. The iodide of starch is, however, of so unstable a composition that it is easily decomposed, even by the saliva; the iodine entering again into soluble *absorbable* combinations, can be again recognised in the urine. In order to prove this, the author gave frequently the iodide of starch. It was prepared in the following manner:—One ounce of wet starch was rubbed up with two drachms of tincture of iodine, and the mass dried. Of this powder there were taken, three times daily, ten grains, corresponding to one quarter of a grain of iodine at a dose. The examination of the urine was conducted in the following manner:—The urine was mixed with some pulverized starch in a small proof glass, then a sufficient quantity of chlorine water was added; the previous white fluid became more or less violet-colored from the presence of the iodine; or a large quantity of urine was evaporated to one-tenth of its volume, then a few drops of sulphuric acid added, and immediately a paper spread with starch paste held over it. In every case, when the iodide of starch had been taken, the author succeeded in detecting the presence of iodine in the urine. Sometimes it was difficult, immediately after the first dose of the iodide, to detect the iodine, there being but a slight reaction, on account of the insufficient sensibility of the reagent, which, however, becomes evident when several doses are given. In such cases, one can use the chloride of palladium, which is extremely sensitive, and leaves no doubt of the final passage of the iodine into the urine. It seems, therefore, unnecessary to deny the use of amylaceous food to patients while taking iodine.

Günnsb. Zetschr. v. 6. 1854., *Schmidt's Jahr.*, and *Philadelphia Med. Ex.*

PRODUCTION of SAFFRON in CASHMERE.

PAMPUR, a large village on the right bank [of the river Jhelum], is celebrated for its saffron grounds. The cultivation of this flower is carried on in nearly every part of this *pergunah*, the local soil being

alone found suited for the purpose. It appeared to consist of a light ferruginous clay, which is excavated near the Jhelum, and carried to the fields by great manual labor. The bulbs are planted out in small square beds in June, weeded and freely irrigated, and the crop is collected in October. The Maharajah and his myrmidons attend the gathering and take the *spolia opima* of the occasion. The drug is sold in the royal bazaar, and I was informed that one rupee *per seer*, was levied as export duty on the trader. It varies in price according to quality. I observed some as low as five rupees the *seer* of two pounds, but this was mixed with very ancient stuff, or what was often worse, with the dried *petals* of the flower. True Saffron (under royal warranty) fetches from seven to ten rupees *per seer i. e.*, in Kashmere coinage,—which is little more than half the East India Company's. Steeping the article in water previous to weighing out is commonly practised, which, in addition to increasing weight, injures its coloring properties irretrievably.

Sometimes the unwary Hindustanee merchant packs it in the damp state, and on reaching the plains, discovers to his great sorrow that the precious purchase has become a mass of mouldy rubbish, unsaleable at a *pice*. This happened under my own observation.—*Lieut. W. H. Lowther* "On the Natural Productions of the Vale of Kashmere." *Journal of the Agricultural and Horticultural Society of India*, vol. viii., part 5, 1854.

PROCEEDINGS OF SOCIETIES.

BRISTOL PHILOSOPHICAL AND LITERARY SOCIETY.

W. P. KING, ESQ., PRESIDENT, IN THE CHAIR.

At the last private meeting of this Society, which was held at the Institution, in Park Street, on Nov. 29th., William Herapath, Esq. read a paper "On the Metals of the Earths."

After making a few introductory remarks, Mr. Herapath observed, that the term *earth* is a generic one, and is applied by chemists to certain metallic oxides which are met with in nature, and form the basis of our clays, flints, sand-stones, lime-stones, &c. The earths are usually subdivided into two genera—the alkaline earths and the earths proper. The most important of the alkaline earths are lime (*calcia*), magnesia, strontia, and baryta; of the earths proper, alumina and silica. The latter, silica, he said, in consequence of its possessing acid properties, is sometimes classified with the acids, and is then termed silicic acid. All of the earths are compounds of peculiar metals and oxygen; thus, lime is composed of the metal calcium and oxygen; magnesia of magnesium and oxygen; alumina, of aluminum or aluminium and oxygen; silica, of silicium or silicon and oxygen; baryta, of barium and oxygen, &c. This fact was first proved by our illustrious fellow-countryman, Sir Humphrey Davy. In the course of some experiments which that chemist instituted at the Royal Institution, in 1808, he observed that when the hydrates of potassa and soda were subjected

to the action of a powerful stream of voltaic electricity, scintillations took place at one of the poles or electrodes of the battery, if water was present; but that when the precaution was taken to cover the alkali with a layer of rock-oil or petroleum, bright shining white globules of metal were obtained, which on examination were proved to consist of the metallic bases of the alkalies, potassium and sodium. Two French chemists, MM. Gay Lussac and Thenard, subsequently ascertained that on heating the alkalies with a mixture of carbon and iron turnings in a gun-barrel to whiteness, the same effect was produced; decomposition ensued, and the potassium and sodium distilled over; and thus these two metals could be manufactured in much larger quantities with infinitely less trouble and expense. The cost, however, of the metals so prepared was still very great—eight guineas the ounce being the retail price; and as a necessary consequence but a small quantity of them was made use of, and that only in purely scientific investigations, or in the performance of class experiments. The total annual consumption of potassium in England, at this period, according to the late Mr. John T. Cooper of London, did not amount to more than one pound in weight. Brünner, a German, however, shortly afterwards showed that by igniting a mixture of carbonate of potassa or carbonate of soda with charcoal, &c., in a cast-iron retort, the metals in question might be manufactured at a much cheaper rate; and the effect of this discovery was to reduce the price to thirty shillings the ounce. They were still, nevertheless, too dear for ordinary purposes, though this reduction in price enabled chemists to employ them in many of their analytical processes; but in the mean time, Davy had continued his researches, and had ascertained that by acting upon the earths in a peculiar way with potassium, it was possible to obtain from them metals which in some respects bore a close resemblance to the metals of the alkalies, but which differed from the latter in being less readily oxidizable; and Wöhler, in 1827, succeeded in simplifying Davy's processes, in such a manner that these metals of the earths could be eliminated with greater ease, and in sufficient quantities to enable chemists to investigate their chemical and physical qualities. Wöhler's process consisted in acting upon the earthy chlorides, in a state of fusion, with potassium at a high temperature, and in then extracting the fused mass resulting from this operation, with water or some other solvent, so as to dissolve out the chloride of potassium produced by the decomposition of the earthy chloride, and thus leave the reduced metal in the insoluble condition. A full description of this process will be found in *Philosop. Mag.* for 1828, vol. 2. The researches of Prof. Wöhler, however, did not receive much attention from the public until M. Sainte-Claire-Deville announced to the Académie des Sciences, at Paris, that by substituting sodium for potassium in the decomposition of chloride of aluminium he had succeeded in manufacturing the metal aluminium in large quantity, at a moderate cost, and had ascertained that it possessed many of the properties of silver, and might consequently be made available as a substitute for that noble metal for many of the purposes to which the latter is now applied. M. Deville's results

were made known to His Imperial Majesty, the Emperor of the French, who graciously communicated to that chemist his desire that a fresh series of experiments on a more extensive scale should be made at his own expense, with the view to ascertain whether aluminium might be extracted at a sufficiently cheap rate to be employed with advantage in the arts and manufactures. The results of these experiments, which were carried on by command of the Emperor at the chemical works of Javel, have not only placed beyond doubt the possibility of eliminating the metal on a large scale by completely industrial processes, but have also secured to science the possession, at a very moderate price, of another very useful metal, sodium, which there is reason to believe will ultimately prove of great value in chemistry and the arts. As a reward for his exertions, the Emperor of the French has recently created M. Deville, an officer of the Legion of Honour, and has likewise conferred the same mark of distinction on M. Wöhler. The manufacture of aluminium on a large scale is effected at Javel in the following manner:—The first step in the process is the preparation of the chloride of aluminium, which is effected by the reaction of gaseous chlorine on a mixture of alumina and coal-tar previously calcined. This mixture being placed in a gas retort, the latter is strongly heated, and a current of chlorine gas is passed over and through the aluminous preparation; the gaseous chloride of aluminium that is given off is then allowed to enter a chamber of masonry, lined with earthenware or porcelain slabs, where it is condensed in the usual manner. In order to purify the chloride of aluminium from a small quantity of perchloride of iron with which it is contaminated, the vapor is passed over points of iron heated to low redness (about 750° to 800° F.), by which means the volatile perchloride, by contact with the iron, is decomposed, and converted into protochloride, which is fixed at that temperature, and is consequently deposited in the purifying chamber. Purified in this manner, the chloride of aluminium forms on condensation fine colorless crystals, which contain but a mere trace of iron. The second step in the manufacture is the preparation of the sodium. This, it is said, is effected by calcining in large retorts an intimate mixture of 1000 parts by weight of dry carbonate of soda, with 150 parts of chalk, and 450 parts of the dry coal of Charleroi. [A description of the apparatus employed, by Mr. Beatson will be found in *THE CHEMIST*, N.S., vol. 2, p. 714.] The process has been made continuous, and the distillatory apparatus only requires a fresh charge when the previous one has been worked off, to be kept in full action, without interruption, for several weeks; and the result is that blocks of sodium of a cubic foot in size are now prepared with as little trouble and expense as were required a short time ago to produce a few grains of the metal. The reaction of the sodium on the chloride of aluminium is carried on in porcelain tubes; and has been thus described by M. Deville:—"200 or 300 grammes of the chloride of aluminium are placed in a wide tube between plugs of asbestos; pure dry hydrogen gas is passed through the tube; and the chloride is heated (the stream of hydrogen being continued) to drive out hydrochloric acid, chloride of sulphur, and

chloride of silicium, which are formed at the same time. A number of porcelain boats, each containing a few grammes of sodium dried between bibulous paper, are then introduced into the tube; and the tube is heated until the sodium fuses, and the chloride of aluminium volatilizes in the atmosphere of hydrogen, and coming into contact with the sodium, is decomposed by it. As soon as all the sodium has disappeared, the porcelain boats are withdrawn from the tube, and introduced into a wide porcelain tube, in which they are heated in a stream of pure hydrogen to a somewhat higher temperature, so as to volatilize the double chloride of sodium and aluminium, which is condensed in a receiver attached to the apparatus." The metallic aluminium which remains behind, is washed with a little water, and refused under a quantity of sodio-chloride of aluminium, in a porcelain crucible, so as to unite the whole of the globules into one, the flux is then pored off, and the metal is cast into small ingots, weighing about 15 or 20 grammes each. The main improvements introduced by Deville in the elimination of aluminium consist in substituting sodium for potassium in the decomposition of the chloride of aluminium; in rendering the preparation of the sodium more simple; and in effecting such alterations in the apparatus employed as to enable manufacturing chemists to prepare sodium and aluminium more readily, in larger quantity, and at a less cost. The price of aluminium at the present time is two francs the gramme (15½ grains), or about £3 10s. the ounce (that of sodium being £2 per pound); but from experiments that have been made by M. Rose, of Berlin, there is reason to believe that a natural mineral, kryolite, a double fluoride of sodium and aluminium, may be economically substituted for the artificial chloride in the process of manufacture with good results. Deville did not succeed in reducing aluminium by electrolysis from an aqueous solution of any of its salts, but Mr. Gore, of Birmingham, has recently shown that by taking certain precautions this metal may be reduced on copper by the galvanic agency from an aqueous solution of hydrochlorate or acetate of alumina, and that it then forms a white or lead-colored deposit, which acquires the lustre of platinum by burnishing [Phil. Mag., 4, vii. 227.]

Bunsen, Debray, and other experimenters have also proved that calcium, magnesium, glucinum, and other metals of the earths, may be prepared in like manner, or by the decomposition of the chlorides by sodium. [Vide various papers that have been published in the last two vols. of THE CHEMIST]. Mr. Herapath then proceeded to point out the most interesting properties of aluminium and the allied metals, and exhibited to the members present several specimens of aluminium in plates, blocks, foil, and wire, and also some beautiful ones of sodium and potassium. He also directed attention to two specimens of aluminium and silicium which had been presented to him by Mr. Gore, and which he said he believed were the first which had ever been prepared by a simple voltaic arrangement. Aluminium is very similar in appearance to silver, but is not so soft or so white in color; it is a good conductor of heat and electricity—its conducting power for the latter fluid being, according to Deville, eight times as great as that

of iron; its melting point, when pure, is between that of silver and that of zinc; if the metal is contaminated with a small proportion of iron or platinum, the fusing point is raised considerably; air has no action on it, and it is not tarnished by sulphuretted hydrogen or sulphide of ammonium; it does not oxidise or rust in moist air, like lead and iron; sulphuric and nitric acids, when cold, exert but a slight action upon it; but muriatic acid dissolves it readily, evolving hydrogen gas; it does not amalgamate with mercury; the fused alkalies do not attack it, but the alkaline carbonates and borax sensibly act upon it—borax is decomposed by it at a red heat, and boron appears to be eliminated. The specific gravity of this metal is said to be 2.56, being increased by rolling to 2.64; that of a specimen prepared by Deville, however, was found by Mr. H. to be as high as 2.66, and when rolled or hammered to rise to 2.74. [*Vide* a paper by Deville in *Ann. Ch. Phys.* (3), xliii. 5, or *Journ. Chem. Soc.* vol. viii. 3, p. 239]. According to M. M. Tissiers, pure aluminium is readily distinguished from the impure, by its greater whiteness, and its indistinct traces of crystallisation. Generally only one or two hexagons can be observed on the upper surfaces of the pure ingots. The impure metal, on the other hand, has a bluish tint, like zinc, and the surface of the ingot exhibits numerous acicular crystals, radiating in different directions. It may be whitened easily by dipping it first into a concentrated solution of caustic alkali, and then immersing it in nitric acid.

The atomic weight of aluminium, the author observed, has been hitherto considered to be 26; but from some experiments he has recently made he was induced to believe that it has not been determined with sufficient accuracy: he is now engaged, however, in working out the subject.

Mr. Herapath then pointed out the best methods of working, annealing, and soldering aluminium, giving the results of his own experiments on the subject. His experience leads him to believe that the best solders for aluminium are alloys of silver or tin with aluminium, the point of fusion of which is below that of the pure metal. Alloys of cadmium may also be sometimes used with advantage. The best fluxes are the alkaline and earthy chlorides, common salt, sodio-chloride of aluminium, &c., and mixtures of these in certain proportions. In working aluminium, the metal should be occasionally annealed by heating it to a moderately high temperature over a wire-gauge gas-lamp, in which an inflammable mixture of coal-gas and air is made use of. [*Vide* Parnell's *Elements of Chemical Analysis* for a description of the apparatus.] Mr. Herapath then alluded to the investigations which had been carried on, by Professor Crace Calvert, of Manchester, in conjunction with Mr. Johnson [*See THE CHEMIST*, Nov. 1855] with the view to ascertain the available alloys of aluminium with other metals; and then passed on to treat of the researches which had been made by M. Junot and Mr. Gore on the electric deposition of silicium. M. Plée, who has written on this subject in the *Siccle*, says—

“If any one was to declare at once, and without any preamble,

that paving-stones were productive of a metal, which can scarcely be distinguished from silver; that saucepans, plates, forks, and spoons were to be got out of a block of sand-stone, one would probably be most unmercifully laughed at,—and yet such is the case; the paving-stones do contain metal, just as beet-roots contain sugar and alcohol; nothing can be more true." In the extraction of the metal silicium, the siliceous materials are fused with potash or soda, and converted into soluble silicate (soluble glass); the latter is then dissolved in water, purified from certain impurities, mixed with a solution of cyanide of potassium and introduced into the decomposing cell attached to the galvanic battery. Articles coated with silicium become white as silver (from which indeed silicium can be hardly distinguished), and attain the highest degree of lustre under the hands of the polisher. "Other Chemists," says M. Plée, "have other processes for the reduction or elimination of silicium, and every body here is setting to work upon it. It is therefore to be expected that a complete alteration will be effected. From clay we shall obtain aluminium; from sand-stone, rock crystal, and sand we shall extract silicium; these metals, given up to industry and the manufactures, may replace silver for domestic purposes, and thus silver may be entirely restored to monetary circulation." Having given a few more particulars with regard to this curious metal and its congeners, Mr. Herapath concluded his lecture by enumerating the various uses to which he believed aluminium and silicium might be applied. They have been already employed in the manufacture of watches, medals, and chemical weights, for mounting spectacles, for electro-plating metal goods, and for the manufacture of various articles made use of by savans and in every day life, and Mr. Herapath said he had reason to believe that they would be in a short time still further utilised.

T. J. H.

BIBLIOGRAPHY.

A CATECHISM OF CHEMICAL PHILOSOPHY: Being a Familiar Exposition of the Principles of Chemistry and Physics, in their Application to the Arts and Comforts of Life: Designed for the use of Schools and Private Tuition. Illustrated by One Hundred and Fifty Wood Cuts. By JOHN HORSLEY, Author of "THE CHEMISTRY OF POISONS," "CHEMICAL EQUIVALENTS," TREATISE ON WATER, &c., London: John Churchill. 1856, pp. 247.

THE author informs us in his preface that his object in the publication of this catechism is "to excite and encourage, if possible, a taste and desire for the study of those sciences which minister so much to the comfort and well-being of society, by progressively presenting each subject in as simple and interesting, yet complete and concise a form as possible; and thinking that the style of question and answer would best attain that end, it has been adopted; the answers in every case professing to be a practical digest, the pith and marrow of scientific facts." This object we consider that Mr. Horsley has succeeded in attaining.

The little work before us is extremely well adapted for the instruction of the young, and on this account it is very likely to become extensively

used in schools. It should be placed in the hands of every intelligent boy, for the principal facts of the science of chemistry should be taught to all, and not merely to the few who may be led to study it among other sciences with the view of entering the medical profession, or in consequence of being apprenticed to pharmaceutical chemists. It would be well, indeed, were an elementary work like this used in every school; we should then bring up a generation of chemists, not necessarily professional chemists, or independent of professional chemists in their avocations, but capable of comprehending the value and utility of the science as practically applied. It is by no means uncommon to meet with persons of intelligence and of decent education, who are quite incapable of comprehending the simplest explanations of ordinary chemical facts and laws: to whom, for instance, the law of combination in definite proportions is as utterly unintelligible as the language of the Iowa Indians: we have met with this ignorance in persons to whom knowledge would have been of great pecuniary value. We therefore urge every parent, to take care that his son shall obtain *some* acquaintance with chemistry, he has only to place in his hand an elementary treatise, not on any consideration the large and valuable Manuals, but a small, easy and familiar book;—we know of none better than Mr. Horsley's for the purpose.

THE ART OF PERFUMERY and the METHODS of OBTAINING the ODORS of PLANTS; with INSTRUCTIONS for the MANUFACTURE of PERFUMES for the HANDKERCHIEF, SCENTED POWDERS, ODOROUS VINEGARS, DENTRIFICES, POMATUMS, COSMETICS, PERFUMED SOAP, &c. By G. W. SEPTIMUS PIESSE, Analytical Chemist. To which is added an APPENDIX on the COLORS of FLOWERS, ARTIFICIAL FRUIT ESSENCE, &c. London: Longman & Co. 1855.

THIS is unquestionably one of the best treatises which has appeared on any art for many years. The author has spared no research, and, in addition to the results of his own practice and experience, has availed himself of the assistance of some of our most distinguished botanists.

The author gives the modes of preparation and extraction of every known kind of odoriferous essence, and the application of each to the production of perfumes, commonly so called, as shown in the title.

It is not our purpose to give a summary of the contents of this valuable work; we must therefore content ourselves with stating that to Chemists and Druggists who are in the habit of preparing articles of perfumery, this work will be found of the greatest utility. Moreover, there are very few who delight in the delicious odors which Nature has given us, who will not read, with pleasure, the very entertaining description of them and of the modes by which the skilful perfumer brings them into the forms with which the public is familiar.

Mr. Piesse may be regarded as probably the very best authority of the day on the subjects he has treated of, as he is professionally connected, we believe, with one of the first perfumery establishments in the kingdom.

We regret that we have not space for an extract this month. We shall, however, probably hereafter extract some passages likely to interest our readers.

NOTICES of NEW CHEMICAL and PHILOSOPHICAL APPARATUS.

UNDER this head it is our intention to describe such new apparatus as may from time to time be brought under our notice, and such preparations as may be sent to us.

Siemen's Improved Air Pump.—In this instrument, as the ingenious Patentee informs us, "an essentially new feature, if not, indeed, virtually a new principle also, has been introduced into the construction of this important machine. The new air pump consists of two cylinders, differing in magnitude, of which the smaller is applied either to the bottom or top of the larger, while the valved pistons belonging to each respectively are attached to the same piston rod. The air withdrawn from the receiver, or other vessel intended to be exhausted, is condensed in the lower cylinder, into one fourth of its original volume, and consequently always possesses sufficient elasticity to pass through the discharging valve and escape into the atmosphere, the opposing pressure of which on that valve is thus counteracted in a perfectly novel manner."

We regret that want of space prevents our giving illustrations showing the construction of this valuable instrument.

The new air pump (manufactured by Messrs. Knight) is cheaper than those of the ordinary construction, especially when its perfection is taken into consideration, and, *ceteris paribus*, if a well made pump, of any of the ordinary constructions, will rarify the air to 99-100, the new one would carry the rarefaction up to 999,999-1000,000, if a certain valve could be rendered automatic; but as it is, it will produce a vacuum approaching to the perfection assigned, in proportion to the smallness of the force required to open the said valve. Those who may require a powerful and perfect air pump will do well to inspect this machine, the capabilities of which were exhibited to us by Mr. George Knight.

The Cosmerama Stereoscope.—This is a modification of the beautiful instrument invented by Sir David Brewster. The improvement consists in employing, instead of the two small semi-lenses, one large one, which is rendered Stereoscopic by cutting an ordinary plano-convex lense in half, removing more or less of the opposite outer diameter, and then transposing the pieces so that the original centre of the lense becomes the two sides, and the outer edges come together. The advantages obtained by this instrument is an increased facility for viewing as one the double pictures: only one adjustment is necessary for all sights, viz, increasing or diminishing the distance between the line and the double pictures. By using larger lenses of proper focal length, pictures of any dimensions may be viewed stereoscopically.

This is a very beautiful and interesting instrument. It is made by Messrs. Knight.

THE CHEMIST.

ORIGINAL COMMUNICATIONS.

On the ELECTRO-CHEMICAL DEPOSITION of METALS.

By ALEXANDER WATT.

(Continued from page 195.)

Electro Deposition of Platinum.—A solution of platinum may be made by dissolving a piece of the metal in two parts of hydrochloric acid and one part of nitric acid over a sand bath. When the metal is dissolved the heat should be continued until all the acid is expelled, when a dark red mass will be obtained, which is the chloride of platinum. A little distilled water is now to be added, to dissolve the chloride. A solution of cyanide of potassium is then added, which will precipitate and redissolve the platinum. Gentle heat is now to be applied and the solution is ready for use. It is, however, advisable to filter the solution before using it, as there is always a sediment formed consisting principally of impurities from the cyanide.

The battery power employed for depositing platinum should be very weak, otherwise the deposit will be of a black color, possessing no resemblance to the metal itself.

The platinum anode used will not be acted upon by the solution, therefore the latter will soon cease to act when it has become deprived of its metal by the article coated. If it is desirable to coat an article strongly with platinum, it can only be done by making a fresh solution as soon as all the metal is worked out of the other. This renders the process of electro-platinising not only expensive and tedious, but, for most purposes, impracticable. The cyanide of potassium will hold but a small quantity of platinum in solution, therefore the solution soon becomes exhausted.

Palladium may be deposited from its solution more easily than platinum. This metal may be dissolved in nitro-hydrochloric acid in the same way as platinum, and when dissolved, heat is to be applied until all the acid is evaporated. A solution of cyanide of potassium is then to be added, which will at once precipitate the palladium and redissolve the precipitate. The solution thus formed should then be filtered, and may be worked either cold or hot, the latter being preferable. Unlike platinum, the palladium anode becomes acted upon by the cyanide, therefore the operator may deposit this metal to almost any thickness he pleases. The electro-deposition of palladium does not, however, seem likely to be of much commercial importance.

Lead.—A solution of lead, from which the metal may be deposited, may be made by dissolving the acetate or nitrate of lead in water—but the acid solutions of this metal seldom yield a good deposit upon metallic surfaces, as the acid which holds the metal in solution, when set free, acts upon the metal to be coated, even after it has received a slight coating, causing the latter frequently to blister or peel off. An alkaline solution of lead, which may be prepared with soda or potassa, is more suitable for experimental purposes, but it is not capable of much practical application.

Nickel may be readily deposited from its solution, by dissolving the metal in nitric acid. The acid is next expelled by heat—when a solution of cyanide of potassium is added until the precipitate formed is redissolved. The solution is then ready for use. It should be worked with a moderate battery power, and with an anode of nickel, which, owing to the extreme brittleness of this metal, should be cast of the size required.

The nickel may also be precipitated from the nitrate with carbonate of potassa, soda or ammonia, and, the precipitate being washed may be redissolved with cyanide of potassium. This is a more economical way of making the solution of nickel than the one above described, and it is in many respects preferable.

The electro-deposition of nickel has not yet been applied to practical purposes.

Iron, may be deposited from a solution of the sulphate, to which a little sulphuric acid has been added. Iron may also be deposited from an alkaline solution, but as this metal is not likely to be deposited for any useful purposes, we will abstain from fully describing the details of the various processes.

Antimony, Bismuth and Cadmium.—These metals may be deposited from either an acid or an alkaline solution, the latter being prepared by precipitating the metal with an alkali, and redissolving with cyanide of potassium.

Tin.—It is rather difficult to form an alkaline solution of this metal, owing to the fact that almost all the salts of tin are very sparingly soluble in the cyanide of potassium. Either liquid ammonia, caustic potassa or soda, however, will be found to answer the purpose of a solvent for some of the salts of tin, and solutions may be made therewith, but of little practical utility.

This metal may also be deposited from a solution of the protochloride, in which case, if the anode and cathode be allowed to approach each other within about an inch and a half, a beautiful mass of crystals of pure tin will shoot out of the negative pole toward the positive, resembling a cluster of metallic ferns. On removing these crystals from the solution, however, they soon lose their beauty, as they are so fragile that they fall with the most trifling motion.

Zinc.—Many persons have tried to deposit this metal from a solution of the sulphate of zinc for practical purposes, but without success, and I have lately been engaged in depositing zinc in large quantities, from other solutions, which are being patented, and I believe that all the

difficulties which have beset the path of the electro-metallurgist in the deposition of this metal will be overcome by the process referred to, and which will be published in due course.

Electro-deposition of Alloys of Metals.—Besides the above metals, I have succeeded in depositing an alloy of nickel with copper, forming a very good quality of German silver; of gold with copper; silver with gold; copper, silver, and gold, and several others, but the only alloy that I am aware of which is capable of being practically worked is that of copper and zinc, forming ordinary brass. This process, in the hands of an intelligent operator, may be worked with considerable facility and success; but the deposition of the other alloys, at all events most of them, is at present merely experimental.

Having been much occupied with some experiments on an extensive scale lately, I regret that I am compelled to give but a short paper this month, I trust, however, next month, to lay before the readers of THE CHEMIST, in the form of an APPENDIX to these papers, a series of practical facts which may be found of considerable service to the practical electro-metallurgist.

These facts, being collected from my note-book, where they have been placed from time to time, during a period of many years, will, I hope, tend to remove some of the obstacles which too often beset the labors of the electro-metallurgist.

(To be continued.)

London, January 15th, 1856.

CHEMICAL TABLES. COMPILED BY THORNTON J. HERAPATH.

No. IV.—Table showing the Behavior of Substances with Reagents, and for Testing by the Blowpipe:—Proximate Organic Analysis.

Distinctive Reactions are printed in *italics*. Precipitants used in quantitative analysis are distinguished by an *.

D'—ORGANIC SUBSTANCES:—BASES, &c.

CLASS III.—SUBSTANCES INSOL., OR BUT SPARINGLY SOL. IN ÆTHER AND ALCOHOL, BUT SOLUBLE IN COLD WATER.

Sub-Class I.—Substances Soluble in Cold Water.

(Continued from p. 199.)

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
Chondrine	Animal.—Cartilage. $C^{72}, H^{50}, N^9, O^{32}?$ Very similar to the preceding. <i>Tartaric, citric, and oxalic acids, permanent ppts. Sulphate alumina and alum, white flakes, insol. in water, but sol. in an excess of the precipitants. Acetates of lead, white ppts.</i>
Soluble albuminous, or proteine compounds .	Veg. and animal. <i>All contain sulphur and nitrogen; are sol. in a hot solu. of caustic alkali, and then blacken the salts of lead; are sol. in boiling hydrochloric acid, yielding a purple solu., which after a time changes to a dark brown; dissolve in strong nitric acid, when heated, and yield a yellow solu. containing xanthoproteic acid. A solu. of sub-nitrate of mercury, when heated to 140°-160°, communicates a deep red color to all albumin. comp.</i> Sp. 1.—Albumine: in most animal and veg. juices. Aqueous solu. coagulates on boiling, but more readily on the addition of <i>dil. nitric* or hydrochl. acid.*</i> Chloride mercury, white ppt., sol. in alkalies. Is pptd. also by ferrocyan. potassium and metaphosphoric acid, but not by ordinary phosphoric acid. Var.—Ovalbumine (white of egg).— $C^{216}, H^{169}, N^{36}, O^{68}, S^2$. <i>Is coag. by ether and by acetic acid and heat, remaining so at all temps.</i> Var.—Seralbumine (of blood-serum).— $C^{216}, H^{169}, N^{37}, O^{68}, S^2$. <i>Is not coag. by ether; and the ppt. with acetic acid only appears on cooling the solu., and redissolves on the application of heat.</i> Sp. 2.—Synaptase or emulsine: only in almonds and in kernels of certain species of <i>pyrus</i> and <i>prunus</i> .

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
	Very similar to albumen. <i>Is pptd. by ordin. phosphoric acid. When digested with a solu. of amygdaline, at a moderate heat, it yields a solution which on distillation gives off hydrocyanic acid.</i> Sp. 3.—Myronine: only in the seeds, &c., of certain <i>cruciferae</i>. Very similar to albumen; but when digested, as above, with myronic acid, it yields oil of mustard, or some compound of allyle. Sp. 4.—Fibrine: in animal and veg. juices. $C^{396}, H^{322}, N^{40}, O^{82}, S^2$. Coagulates spontaneously, and is converted into insol. fibrine, q.v. Sp. 5.—Caseine, or legumine: in milk, seeds of <i>Leguminosa</i>, vegetable juices, &c. $C^{288}, H^{228}, N^{34}, O^{90}, S^2$. <i>Is disting. from fibrine and albumen by its not coag. either spontaneously or by heat, and by forming a skin or pellicle when its solu. is evap. It is coag. by dilute acids, which are unable to coag. albumen.</i> Sp. 6.—Pepsin, or gasterase: in the juices of the stomach. <i>When digested with flesh, coag. albumen, &c., at a temp. of 98°-100°, it causes them to become soluble in water. It is disting. from albumen by its solu., being pptd. by dil. acids; the ppt. re-dissolving in an ex.; and from caseine by its acid solu., not being pptd. by prussiate potash.</i> Sp. 7.—Hæmatosyne, or hæmachrome; in the coloring matter of the blood. <i>It contains a large proportion of iron. Its aqueous solu. is brown or brownish-red colored, and on boiling deposits a brown sediment, which is readily soluble in ammoniacal alcohol and in alkal. solu., with a red color. It is turned brown by chlorine and by a solution of hypochlorite of lime, and is thus distinguished from most vegetable coloring matters.</i>
<i>Sub-Class II.—Substances Insol. in Cold Water, but Soluble in Hot Water.</i>	
Lichen starch, or lichenine	Veg.—In Iceland moss, &c. $C^{12}, H^{10}, O^{16}=162$.
Inuline	Swells up into a transparent jelly with cold water, but dissolves entirely in hot water. <i>Is colored dingy green by a solu. of iodine; and is converted by acids into glucose and gum.</i> Veg.—In roots of the <i>dahlia</i>, elecampagne, bog-bean, <i>datiscus</i>, dandelion, &c. $C^{12}, H^{10}, O^{16}?$
	Readily sol. in hot water, and deposited, on cooling, in small granules. <i>Is colored yellow by iodine.</i>

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
<i>Pectic acid</i>	Veg.—In many plants. Is very similar to pectin, <i>q. v.</i> Is sp. sol. in boiling water, but is converted by it into <i>pectosic acid</i>, which is readily sol. Is readily sol. in alkal. solu., and is reprecipitated by acids. Is not affected by iodine, and has no action on copper solu.
Tragacanthine, or bassorine	Veg.—In many plants. Acts in a nearly similar manner towards reagents as arabin.
<i>Gelatinous tissues</i> . .	When boiled with water yield gelatine and chondrine, <i>q. v.</i> <i>Sub-Class I.</i>
Certain vegetable coloring matters . . .	<i>Vide</i> various works on chemistry.
<i>Sub-Class III.—Substances Insol. in Water, both Hot and Cold, but which are rendered Gelatinous by Hot Water.</i>	
Starch (<i>Amylum</i>) . . .	C^{12}, H^{10}, O^{10}, or C^{24}, H^{20}, O^{20} = 162 or 324. Compos.—C, 44.444%; H, 6.174%; O, 49.382%. Under the microscope, it is seen to consist of minute colorless granules, which differ somewhat in size and shape in different plants:— 1. <i>Granules nearly Spherical.</i>—Wheat, size very variable, most common size, 1-500th of an inch; barley, less variable, 1-500 to 1-400th. 2. <i>Granules more or less Ovoid.</i>—Canna starch (<i>tous les mois</i>), 1-350 to 1-260th; potato starch (<i>English arrowroot</i>), 1-400 to 1-300th; sago, pretty uniform, about 1-400th; rye, largest 1-500th; tapioca, uniform, 1-900th; Russian semolina, 1-800th; orchidaceæ, 1-2500th; Arum starch (<i>Portland Ar.</i>), 1-4348th; millet, 1-10,000th. 3. <i>Granules more or less Polygonal.</i>—Oats, about 1-500th; yams, somewhat triangular, 1-500th; Indian corn, 1-800th; rice, 1-5263th. [<i>Vide</i> also Pareira's <i>Materia Medica</i>, vol. ii, part I.] Starch is colored generally dark blue by an aqueous solution of iodine, and of a fine yellow color, by bromine. When exposed to the action of iodine-vapor, the different varieties of starch act as follows:— Wheat starch becomes violet; potato starch dove-gray; genuine arrow-root, bright chocolate color; genuine tapioca, yellowish, or chamois color; spurious tapioca, some granules violet-grey, others yellowish, or chamois-colored; white sago, ditto Starch does not reduce the salts of copper or silver; and is converted by dil. acids and heat into dextrine and glucose. By strong nitric acid and heat it is converted into oxalic acid.

Bases, &c.	Source, Formula, Atomic Weight, Composition per Cent., and Action of Special Tests.
Paramylon . . .	Veg.—In infusoria. Occurs in small irregular pieces or in granules. Is not colored blue by iodine, but with other reagents acts like starch.
Amyloid corpuscles . . .	Animal.—In the brain, blood, &c., of animals. Occur in granules like starch, and are colored purplish-blue by an aqueous solu. of iodine, the color becoming deeper on the addition of dil. sulphuric acid (3 parts of acid+1 part of water).
CLASS IV.—SUBSTANCES INSOLUBLE IN ÆTHER, ALCOHOL, AND WATER.	
Cellulose . . .	Veg.—Forms the cellular tissue, &c., of plants. $C^{64}, H^{91}, O^{21}=333$. Is insol. in alk. solu., and in dilute acids; but by boiling dil. sulphuric acid is converted into glucose, and by boiling nitric acid into oxalic acid. <i>Is not colored by an aqueous solu. of iodine, but when treated successively with dil. sulph. acid (3 or 4 pts. of oil of vitriol to 1 pt. of water) and an aqueous solu. of iodine, it assumes a fine purple-blue color. The same effect is produced by a solu. of iodine in chloride of zinc.</i>
Pollenin . . .	Veg.—Comp. uncertain; contains N. Under the microscope is seen to consist of colorless or pale-yellow membrane. <i>Becomes brownish-yel. when treated with solu. of iodine; and assumes a yel. color with nitric acid.</i>
Incrusting, or woody matter . . .	Veg.—Comp. uncertain; is not nitrogenous. Consists of minute amorph. granules. Is colored yellow or brownish-yellow by the iodine solu. When boiled with dil. solu. of caustic alkali, it yields a brown solu. from which a brown ppt. may be obtained on supersaturation with an acid.
Albuminoid, or proteine compounds (insol. var.)	<i>Vide Class III.</i> Are sol. in alk. solu., and are reppt. by acids. With other reagents act like the sol. var.
Indigotin . . .	Veg. and animal.—In woad, indigo plant, and occasionally in urine. Is insol. in bisulp. of carbon and in alkalies; is sol. in very strong sulp. acid, yielding a fine blue solu., which may be decolor. by chlorine and by nitric acid. It yields aniline on destruct. distil., and is converted by heat and nitric acid into carbazotic acid, &c.
Carotin . . .	Veg.—Only in the carrot. Is sol. in bisulp. carbon, yielding a red solu.
Cystine . . .	Animal.—Only in urinary calculi. <i>Is sol. in acids and alkalies, crys. from its ammon. solu. in beautiful colorless hexagonal plates. It contains sulphur.</i>
Xanthic oxide . . .	Animal.—Only in urinary calculi. Is sol. in alkali, and repptd. by acids as a white powder.

MINERALOGY.

OCCURRENCE of NATIVE IRON *in* LIBERIA *in* AFRICA.

From a letter of Dr. A. A. HAYES, Chemist, Boston, U. S., to Professor H. D. ROGERS.

DR. HAYES states that there is evidence establishing the fact that *pure native* iron exists abundantly in the country back from the central part of the colony of Liberia. Early travellers state that the natives of Africa find iron *ore* so pure that they heat and hammer it into form. Explorations by the Liberians show that the inhabitants of towns are engaged in manufacturing iron, and an intelligent native has recently shown how it is done. Last year a mass was sent home by a working blacksmith, who cut it with a chisel from a mass of larger size connected with rock. This proved to be native iron, malleable and ductile, yet unequal in its molecular structure. The general arrangement of the particles is unlike that of any artificial iron known, and there are among the iron, particles of crystalline and transparent quartz, octahedral crystals of magnetic oxide of iron, and one of the silicates of soda and lime. No traces of carbon exist in connection with it, and no piece of artificial iron has yet reached Dr. Hayes which *does not contain carbon*. When analysed by Dr. Hayes's mode of electrolysis, it rapidly shows points which are positive to the surrounding portions, and, the action proceeding, the mass becomes honeycombed in texture, while the final chemical result is:—

Pure iron,	98.40
Quartz, magnetic oxide iron, and silicate lime,	1.60
	100.

The positive points are the crystalline aggregates of the simple minerals, the iron in immediate contact being more open in texture, and always positive in relation to the crystals which are negative.

Professor Rogers supported the view taken by Dr. Hayes of the genuineness of the alleged native iron from Africa, by testifying to the experience of that chemist in the technical examination of manufactured iron, and by the statement of his belief, derived from a comparison of many analyses, that the presence of carbon in an iron is the best test of its having been artificially brought to the metallic state. The reputed telluric iron of Canaan in Connecticut, is almost the only instance in which an alleged native iron has been reported to have been met with, not in loose masses but in the form of a mineral lode, that of Canaan being stated to be a true vein two inches thick in mica slate. The detection of carbon in this iron proves the specimens to be spurious, and confirms an impression long prevalent among American mineralogists, that the original statement about this vein was founded either in mistake or fraud. An examination of the best authenticated records of native telluric iron tends certainly to reduce the number of the genuine instances, if we accept the carbon test, yet the authorities for the existence of such are too many and too respectable to justify the

general incredulity in regard to the presence of native iron on our globe. The statement that this African iron is manufactured in seven villages, is an intimation that it exists in considerable quantity, more than would be compatible with the supposition that it is merely a large mass of meteoric iron. But the fact, particularly significant, against its being native meteoric iron, is the total absence of nickel from its composition, as shown in the full analysis given by Dr. Hayes. The absence of carbon indicates it not to be of human fabrication; that of nickel proves it not to be meteoric. Should it really be shown by further exploration to exist in any quantity, its occurrence on the frontier of a Liberian colony, by presenting another incentive to the settlement of that region by civilized men pursuing the arts of peace, cannot but be regarded as full of good omen for the cause of humanity in Africa.

Edinburgh New Philosophical Mag., Jan., 1856.

OCURRENCE of VANADIUM and TITANIUM in SPHÆROSIDERITE from
the NEIGHBORHOOD of BONN.

By PROFESSOR BÆDEKIR.

THE author selected the largest nodules from this locality, and found that they all contained vanadium. The powdered mineral is fused with nitre, silica, and alumina separated by carbonate of ammonia, and the greater part of the potash removed by crystallisation. The solution is then boiled with sulphuret of sodium, and the green precipitate of oxide of vanadium slowly dissolves, forming a brown solution, from which the brown sulphuret of vanadium was precipitated by an acid and converted into vanadic acid by roasting. By heating with bisulphate of potash, extraction with cold water and boiling, a precipitate was obtained, in which the presence of titanium was distinctly ascertained.

Annalen der Chemie und Pharmacie, vol. xciv., p. 355.

NOTICE of the OCURRENCE of METEORIC LEAD in METEORIC IRON
from TARAPACA, CHILI.

By M. FORSTER HEDDLE, M.D.

A DESCRIPTION of this iron, with analyses and a notice of the occurrence of lead in its cavities, having been inserted in the July number of the Philosophical Journal, I have, on the present occasion, little left me except to exhibit the specimen.

Mr. Greg having observed globules of a bluish metal filling up small nests in the iron, sent them to me for examination; and it was a singularly interesting circumstance that Professor Shepherd, of America, who has devoted so much attention to meteoric bodies, was inspecting my collection when the chips of metal reached me, and witnessed the preliminary investigation which introduced lead as one of the elements of those mysterious bodies which visit us from parts unknown.

By as careful and complete an analysis as the small quantity of metal at my disposal enabled me to institute, I was able to detect no substance

in these chips but metallic lead. When those portions of the globules which had been in contact with the iron were examined, small quantities of iron and alumina, with traces of magnesia and phosphorus were likewise found.

Two supposed new mineral substances which occur in this iron are in my hands for examination; the analyses of these when completed I will lay before the society.

Slices of the iron which contains this meteoric lead have the high value which is always attached to unique specimens; and it is satisfactory to know that, through the generosity of Mr. Greg, one of the slices is now in the College Museum.

METALLURGY.

On a New and ADVANTAGEOUS PROCESS for PREPARING ALUMINIUM. By M. ROSE.

FOR some time there has appeared in commerce, under the name of *mineral soda*, large quantities of cryolite or double fluorite of aluminium and sodium. This substance, which the Danes obtain from Greenland, is sent from Copenhagen to Prussia, where it is used in the manufacture of soap.

When boiled with milk of lime, after pulverisation, it is completely decomposed. It forms fluoride of calcium, caustic soda, and alumina, which remains in solution. This aluminous ley is advantageously used in the manufacture of soap.

By means of its composition, cryolite is very fit for the preparation of aluminium. Fixed, anhydrous, not deliquescent, and capable of being reduced to a fine powder, it presents advantages which chloride of aluminium and the double chloride of aluminium and sodium do not. To reduce this compound with sodium the following method has been used; the finely pulverised cryolite is placed in layers with plates of sodium, in a small iron crucible, of 46 millimetres in height and 4 centimetres wide at the upper part. Having pressed the mixture firmly down it is covered with chloride of potassium, and the crucible closed with a good porcelain lid. By reason of its feeble density, chloride of potassium is the best flux that can be used. An equal weight is taken of it and of cryolite, and two parts of sodium are used to five of cryolite. The crucible is heated for half an hour by means of a flame of gas with a powerful draught of air. After cooling, the mass is detached by a chisel and slight blows of a hammer, which are applied to the outside of the crucible.

Fluoride of sodium is but sparingly soluble in water; the addition of chloride of potassium increases its solubility. After digesting the mass for twelve hours with water in platinum or silver vessels,* it is crushed in a mortar. Globules of aluminium will be found in it,

* Porcelain vessels would be powerfully attacked by the solution of fluoride of calcium.

some weighing 0.3 and 0.4 gr. and some smaller. After separating the larger ones the whole is treated with dilute nitric acid. This acid does not dissolve the alumina formed during the operation by the oxidation of the reduced aluminium, but it gives their full brilliancy to the little globules, and thus renders them easily distinguishable. After drying the mixture, the alumina and cryolite are separated by rubbing it through a silk sieve. The fine powder passes and the little globules of aluminium remain on the gauze. The best process for combining these little globules is to fuse them, as recommended by M. Deville, in a crucible porcelain under a layer of double chloride of aluminium and sodium. The salt is fused first, and the globules are introduced by degrees. When chloride of potassium is used as a flux, a certain quantity of aluminium is lost, and the surface of the metal is never perfectly smooth.

The proportion of aluminium obtained by this means differed very much in the several experiments. By employing 10 grammes of cryolite, a quantity which ought to have given 1.3 gr. of metal, the maximum obtained was 0.8 gr., sometimes 0.4 gr. and 0.6 gr., often 0.3 gr. and even less. These variations in the yield depend upon the temperature to which the mass has been exposed, upon the proportion of sodium employed and the duration of the cooling. When the fused liquid has cooled slowly, a portion of the metal oxidises and is transformed into alumina.

The process which I have described has only been the subject of a few experiments. It could doubtless be much improved, and I think it will be useful from the cheapness of cryolite and the ease with which sodium can now be obtained, thanks to M. Deville's valuable investigations.

The globules of aluminium which I obtained were in general very ductile, and they could easily be reduced into very thin plates without any cracks round the edges. These plates were very brilliant. On the contrary, the globules found at the bottom of the crucible, or the masses which floated and did not assume a globular form, cracked when made into sheets, and could be distinguished both by their color and lustre from the pure metal. This brittle aluminium is evidently impure, and probably contains iron.

Like M. Deville, I have frequently found crystalline aluminium. A voluminous globule assumed a texture which was radiated on the surface. M. Deville thinks that he has observed regular octohedra, but he has not been able to ascertain the fact distinctly. From my brother's observations, these crystals do not appear to belong to any regular system.

Having tried to fuse a flattened mass of accidentally impure aluminium, I saw globules of fused metal issue from the mass before the latter was fused. This was pure aluminium, which separated from the impure and less fusible metal in consequence of a species of division analogous to that which M. Schneider observed with respect to impure bismuth.

Poggendorff's Annalen, vol. xcvi. p. 152.

NEW METHOD of PREPARING ALUMINIUM *and* some SIMPLE BODIES,
METALLIC *and* NON-METALLIC.

By M. H. SAINTE CLAIRE DEVILLE.

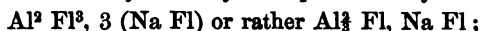
DURING the last two years I have made a series of experiments to determine precisely the equivalent of aluminium, by operating on small quantities of metal of absolute purity; then, to check my first numbers I tried various methods to obtain rather larger quantities of pure matter. I failed for a long time, in consequence of the nature of the vessels usually employed; but this first difficulty was overcome by means which I shall shortly have the honor of laying before the Academy. A second obstacle resulted from the foreign matters which always accompany aluminous compounds; fortunately large masses of a hitherto very scarce mineral were found a few months back, the cryolite of Greenland, an almost pure double fluoride of aluminium and sodium. MM. Hofmann and H. Rose, have sent me several kilogrammes of this substance, with which I have made several experiments.

In England a certain quantity of aluminium has been extracted from the cryolite by means of the battery; but M. Rose's experiments first showed the possibility of extracting the metallic matter from this mineral, and for that purpose, he used sodium. For this reduction it is sufficient to put into a porcelain crucible alternate layers of sodium and of pulverised cryolite mixed with a little common salt. The porcelain crucible is introduced into an earthen crucible and kept at a red heat until the fusion of the contents is complete. The matter is agitated with an earthen stirrer and allowed to cool. All the aluminium is found in a button at the bottom of the cooled mass. While the matter is liquid, and even when partially solidified on the surface, a combustible gas is seen to disengage itself, to raise the thick crust and to inflame in the air. This is doubtless a phosphuretted vapor, as indicated by its odor, and moreover molybdate of ammonia enables us to prove the presence of phosphorus in cryolite. This is the process which I employ and differs but little from that of M. Rose. When we operate in a porcelain crucible the aluminium contains silicium; it contains iron if we use an iron crucible, as M. Rose says, he has however obtained aluminium of very great ductility.

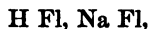
This experiment suggested others to me; I had often, and for a long period, endeavored to reduce the double chloride of aluminium and sodium by means of sodium; although the reaction was perfectly performed I did not obtain a metallic button (M. Rammelsberg arrived at the same result); but the addition of a little fluoride of calcium was sufficient to cause all the aluminium to unite in buttons at the bottom of the crucible. This experiment, which MM. Debray, and Paul Morin tried for me, during my absence, in the laboratory of the *Ecole Normale*, always succeeded well, and they thus prepared some hundreds of grammes of very pure aluminium. It will be seen that the alkaline fluorides which dissolve alumina, should be considered as the best flux

for aluminium. This appears the explanation of this experiment, which seems to me to give a very advantageous process for the manufacture of the metal.

The composition of cryolite may be represented by the formula



if this latter formula be compared with that of hydrofluorate of fluoride of sodium,



it may be seen that, in this latter salt, it is sufficient to replace the H by $\text{Al}^{\frac{2}{3}}$ to have cryolite. If then we take hydrofluorate of fluoride of sodium and calcined alumina in the proportions indicated by these formulæ, mix them intimately and heat them gradually in a platinum crucible, very little hydrofluoric acid is disengaged, and at a moderate temperature we obtain a very fluid, very limpid matter, whose weight corresponds very nearly to that of cryolite, calculated from these formulæ. Treated with sodium, the new matter gives aluminium, which proves that it is formed of fluoride of aluminium, and not with alumina. Analysis shows that this is the same fluoride and the natural fluoride of aluminium and sodium.

The same result may be obtained by mixing alumina and fluoride of sodium and sprinkling them with concentrated hydrofluoric acid. The mass heats, it is dried and melted, and the aluminium removed. The same experiment also succeeds with fluoride of potassium; moreover, if the latter is kept in excess in the mixture, the matter after fusion, may be treated with water, which dissolves the fluoride of potassium and leaves a very fusible crystalline substance, which is, doubtless, cryolite with a base of potassa, or some analogous body; for aluminium can be extracted from this mixture.

In all my experiments I have found it difficult to avoid silica well enough to prevent the aluminium from containing considerable proportions of silicium. Moreover, the per centage obtained from cryolite, and especially from the artificial cryolite, are, as M. H. Rose has likewise found, very small.

In the course of these experiments, I have often proved that peculiar property of the alkaline fluorides which renders them almost general solvents at a high temperature. This is readily shown by taking a very fusible mixture of fluorides of potassium and sodium: a great deal of silica and some titanous acid will dissolve in it at a red heat, likewise, alumina and many other matters; and it is singular that this addition of a foreign matter should cause fusibility and communicate to the bath a fluidity comparable to that of water.

It struck me that a substance of this description, which is readily traversed by electric currents, would be an excellent excipient for matters which, in ordinary conditions, resist the action of the battery. And in fact, by dissolving silica in a double alkaline fluoride and passing a current through it, silicium is produced which, by employing an electrode of platinum, would form an alloy with this metal. At the positive pole, bubbles are disengaged which can be nothing but oxygen.

This is not fluorine: for if a certain quantity of common salt is added to the bath, no odor of chlorine is perceived, and it is well known that chlorides are decomposed before fluorides. The same experiment gives analogous results with titanous acid.

But with alumina it is very different: the double alkaline fluoride dissolves a little, and, under the influence of the electric current, sodium is burnt at the negative pole and fluorine is disengaged at the positive pole; it may be recognised by the powerful odor of hydrofluoric acid, which is developed in the flame of the lamp in which the experiment is tried, (this effect is easily understood when we remember M. Frémy's beautiful experiments on the electrolysis of the fluorides.) All this proves; 1st—that alumina resists the reaction of the battery more than the alkaline fluorides do; 2nd—that alumina cannot be reduced by sodium, which we suspected previously; 3rd—that the direct contrary is the case with respect to silica.

Silica is, in fact, reduced by sodium, and I have easily succeeded in preparing silicium, by putting silica, or very pure powdered glass in contact with the vapor of sodium. This silicium is precisely similar to that prepared with chloride of sodium.

The only difficulty met with in the experiments which I have described proceeds from the nature of the vessels which have to be used and the alterability of the electrodes; for retort carbons soon crumble in baths of fluorides when used, for example, in the preparation of silicium. I am now making experiments on this subject, and the results will shortly be laid before the Academy, with all their details, which require too much explanation to be given in this extract.

Comptes Rendus, No. 24, December 10th, 1855.

ORGANIC CHEMISTRY.

On the TRANSFORMATION of TOLUENE into BENZOÏC ALCOHOL and TOLUIC ACID.

By STANISLAS CANNIZZARO, Professor of Chemistry in the College of Alexandria. (Piedmont).

SOME Chemists consider the hydrocarbons homologous to acetene $C_n H_{n+2}$ as starting points for the alcoholic series, and as the links which unite one series to the other. To render this idea more fertile, it must be demonstrated that, by means of each of these hydrocarbons we might obtain the corresponding alcohol and the superior acid. It would be necessary, for example, to convert acetene, on one hand into methylic alcohol, and on the other, into acetic acid. The question would have been solved if we could have demonstrated the identity of monochlorated acetene with chloride of methyle, because, by means of this chloride, we might have obtained, on one hand methylic alcohol, and on the other, cyanide of methyle, which should be regarded as monocyanuret of acetene, and whose conversion into acetic acid was known.

The identity of monochlorated acetene has long been suspected without having been demonstrated experimentally; but recently, doubts have arisen as to this identity, and hitherto, in no case has the conversion of a hydrocarbon $C_n H_n + 2$ either into alcohol, or into an acid $C_n H_n O^4$ been effected.—(See THE CHEMIST, New Series, Vol. II, page 476).

Having studied benzoic alcohol and having observed the numerous analogies which this alcohol of a new class has to the alcohols $C_n H_n + 2O^2$, I put to myself the following questions.

Toluene being to benzoic alcohol and to toluic acid what acetene is to methylic alcohol and acetic acid, is monochlorated toluene identical with benzo-hydrochloric ether? Can the transformation of toluene into benzoic alcohol and toluic acid be realised?

I solved these questions affirmatively. Beginning with toluene, I prepared benzoic alcohol identical with that which is prepared by the action of hydrate of potassa on essence of bitter almonds, and an acid which has the formula of toluic acid.

These results lead me to hope that by means of the other hydrocarbons analogous to benzene I might obtain the other alcohols and the other homologous acids, and thus fill up the numerous gaps which exist in all these series.

The following are some of the details of my experiments :—

The toluene which I employed was prepared with the benzine of commerce. For the fractioned distillation, I employed an apparatus similar to that which M. Wurtz used in the preparation of butylic alcohol. (See THE CHEMIST, Nov. 1852, page 53, and Oct. 1854, page 18, for two memoirs by M. Wurtz on butylic alcohol). I collected the portions which passed over between 108° and 115° C. (226° 4' and 239° F.) For the use I had to make of it a more precise purification was unnecessary. To convert the toluene into monochlorated toluene I distilled it in a current of dry chlorine; I collected separately the last products, which were denser than water, and I repeated the same treatment on the first products which were lighter than water. I washed the liquid obtained, with water, and with a concentrated solution of caustic potassa; I dried it over chloride of calcium, and I distilled it, I collected the portions which passed over between 170° and 180° C. (338° and 356° F.); I submitted this liquid to several rectifications, collecting as a pure product that which distilled over between 175° and 176° C. (347° and 348° 8' F.)

The monochlorated toluene thus obtained was identical with the chloride of benzehyle prepared by passing a current of dry hydrochloric acid over benzoic alcohol. The complete depuration of both monochlorated toluene and benzhydrochloric ether presents difficulties, because they are partially decomposed by distillation, disengaging hydrochloric acid. This explained to me why in the comparative study of their physical characters, I frequently could not obtain that perfect coincidence which I desired.

I purified them as near as I could by distilling both *in vacuo* and examining their intermediate products.

The monochlorated toluene submitted to analysis gave the following results :—

I.—0.392 gr. of matter gave 0.204 gr. of water and 0.946 gr. of carbonic acid.

II.—0.3615 gr. gave 0.183 of water and 0.874 gr. of carbonic acid.

These results, brought into hundreths give :—

	Calculated.		Theory.
	I.	II.	
Carbon .	65.74 ...	66.02	C ¹⁴ ... 66.42
Hydrogen .	5.77 ...	5.67	H ⁷ ... 5.53
			Ch.

Its density, at 0° (32° F.), is 1.117; the greater part distils over between 175° and 176° C. (347 and 348° 8' F.). The chloride of benzethyle, prepared by means of benzoic alcohol, distils for the most part at the same temperature. I determined the density at 0° C. (32° F.) of two portions of this ether resulting from different preparations, and I obtained the following numbers :—1.1136 in one and 1.1179 in the other. There is, therefore, no constant difference between the physical characters of monochlorated toluene and chloride of benzethyle.

But the identity of the products which they give in the same conditions demonstrated their identity better than the comparison of their physical properties.

Both with an alcoholic solution of potassa give chloride of potassium and a mixed ether $\left. \begin{matrix} C^4 & H^5 \\ C^{14} & H^7 \end{matrix} \right\} O^2$, double oxide of ethyle and benzethyle.

Both may be distilled over caustic potassa without altering them perceptibly.

With acetate of potassa, they give acetate of benzethyle; and, with cyanide of potassium, they give cyanide of benzethyle.

It was by means of the last two reactions that I prepared benzoic alcohol and toluic acid from toluene.

I employed the following process for converting monochlorated toluene into benzoic alcohol.

Monochlorated toluene was boiled for two or three hours with a concentrated alcoholic solution of acetate of potassa, in a flask connected with a Liebig's refrigerator, inclined in such a manner that the condensed products continually returned into the flask.

The liquid, when cooled, was filtered in order to separate the chloride of potassium, and it was boiled again to ascertain that no more of this last salt was formed; the greater part of the alcohol was distilled in a sand bath; the remaining liquid was separated into two layers; the upper layer was distilled. That which passed over at 210° C. (430° F.) was acetate of benzethyle.

The acetate of benzethyle thus obtained was submitted to long boiling with a concentrated alcoholic solution of potassa; the greater part of the alcohol was distilled on a sand bath; the liquid remaining was separated into two layers. The upper layer contained the benzoic alcohol. It was distilled, that which boiled at 204° C. (399° 2' F.) was collected. It was rectified twice. The product thus obtained was an oil denser than water, which distilled at 204° C.

Submitted to analysis it gave the following results.—

- I.—0.281 gr. of matter gave 0.1985 gr. of water and 0.799 gr. of carbonic acid.
 II.—0.3015 gr. of matter gave 0.206 gr. of water and 0.855 of carbonic acid.
 III.—0.337 gr. of matter gave 0.228 gr. of water and 0.959 gr. of carbonic acid.
 IV.—0.468 gr. of matter gave 0.316 of water and 1.327 of carbonic acid.

These results, brought into hundredths, give

	I.	II.	III.	IV.
Carbon . .	77.54 ...	77.34 ...	77.60 ...	77.32
Hydrogen . .	7.84 ...	7.58 ...	7.50 ...	7.49

numbers which correspond with the formula :—

C ¹⁴	.	.	.	.	.	.	.	77.77
H ⁸	.	.	.	.	.	.	.	7.40
O ²	.	.	.	.	.	.	.	14.83
								100.00

Benzoïc alcohol thus prepared, treated with nitric acid diluted with about 10 volumes of water, is converted into essence of bitter almonds. I treated this essence with a solution of bisulphite of soda, and I obtained the crystallised compound described by M. Bertagnini. I decomposed this combination with carbonate of potassa, and I obtained the essence with all its characters. There remains, therefore no doubt concerning the identity of the benzoïc alcohol obtained from toluene with that which is obtained with essence of bitter almonds.

To convert monochlorated toluene into toluic acid, I employed the following process.

I boiled monochlorated toluene with a concentrated alcoholic solution of cyanide of potassium. I filtered, to separate the chloride of potassium formed, and I ascertained, by further boiling, that no more chloride was deposited. I then distilled over the greater part of the alcohol. The remaining liquid was separated into two layers; the upper layer contained the cyanide of benzethyle. I submitted it to long boiling with a concentrated solution of caustic potassa until everything was dissolved and no more ammonia was disengaged. Then I added water to the liquid which became a little turbid. I filtered it and concentrated it a little. I precipitated the toluic acid, with hydrochloric acid, and separated it with ether, which rapidly dissolves it. By evaporating the ethereal solution, the impure acid is obtained. To purify it, I dissolved it in baryta water, and precipitated the excess of baryta with carbonic acid. From the filtered and concentrated solution, I precipitated the toluic acid, which I separated by agitating the liquid with ether, and evaporating the ethereal solution. When the product was still yellowish, I repeated the same treatment. Finally, I crystallised it by cooling in water several times. I thus obtained it crystallised in white needles or in small pearly plates. It fuses below 100° C. (212° F.); at a high temperature, it distils without appreciable decomposition. It cannot be sublimed like benzoïc acid and toluic acid prepared with cymene, because, in fusing at a temperature very distant from the boiling point,

it falls liquid before crystallising. Its vapors are as acrid as those of benzoic acid. It is soluble in cold water, and more soluble in hot water; the solution reddens litmus; it is very soluble in ether.

The silver salt is obtained by precipitating the baryta salt with nitrate of silver; it is deposited under the form of a white coagulated precipitate; it is soluble in water, and deposits from it in great part by cooling.

The various samples resulting from different preparations, gave the following analytical results:—

I.—0·446 gr. of matter, prepared by the method described with the chloride of benzethyle resulting from benzoic alcohol, gave 0·227 gr. of water and 1·160 of carbonic acid.

II.—0·825 gr. of the same matter, after a second crystallisation, gave 0·182 gr. of water and 0·839 gr. of carbonic acid.

III.—0·256 gr. of matter, prepared with monochlorated toluene, gave 0·141 gr. of water and 0·668 gr. of carbonic acid.

IV.—0·332 gr. of the same matter recrystallised, gave 0·179 gr. of water and 0·862 gr. of carbonic acid.

These results, brought into hundredths, give:—

	I.	II.	III.	IV.
Carbon . . .	70·9 ...	70·39 ...	70·15 ...	70·81
Hydrogen . . .	5·6 ...	6·21 ...	6·11 ...	5·98

which lead to the formula



which requires

Carbon	70·588
Hydrogen	5·882
Oxygen	23·530
	100·000

This formula was verified by the following determinations of silver:—

I.—0·1805 gr. of the silver salt, prepared with the toluic acid, with which the 1st and 2nd combustions were operated, left 0·058 gr. of silver.

II.—0·337 of silver salt, prepared with the acid of which the 3rd and 4th combustions were made, left 0·239 gr. of silver.

III.—0·121 gr. of the same salt left 0·054 of silver.

These results give, in hundredths:—

	I.	II.	III.
Silver	44·444 ...	44·50 ...	44·62

The formula



requires 44·444 per cent. of silver.

Is the toluic acid thus obtained identical or only isomeric with that resulting from the action of nitric acid on cymene? The character which leads me to doubt their identity is the possibility below 100° C. (212° F.) of the acid studied by me. The various samples which I have obtained very well crystallised, and resulting from various

preparations, all fused in the water bath; but I was not able to ascertain that they had an uniform fusing point; so that the doubt still exists in my mind that a very small quantity of some foreign matter, which does not prevent crystallisation, considerably lowers the fusing point, which moreover would be in accordance with the small excess of carbon which some of my analyses gave.

But I doubt not that with a larger quantity of water I could purify the acid so as to study its physical properties comparatively with those of the acid obtained by the action of nitric acid on cymene.

I shall not fail to transmit for the judgment of the Academy the results of this study.

Annales de Chimie et de Physique, December, 1855.

On the SAPONIFICATION of the NEUTRAL FATTY BODIES by SOAPS.

By M. J. PELOUZE.

ONE of the oldest and most skilful candle makers, M. de Milly, has shown to the jury of the *Exposition Universelle* a very important modification in the process of saponification of fatty matters, and especially of suet, by lime. He has ascertained that the proportion of lime necessary for this saponification, which he had already reduced from 15 to 8 or 9 per cent. of the fatty matter, might be still further reduced to half and come down to 4 per cent., on the sole condition of subjecting the mixture of lime, water, and fatty matter to an elevated temperature. The operation has been performed on some thousands of kilos. of suet at a time, in a metallic boiler, maintained for several hours at a temperature corresponding to a pressure of 5 to 6 atmospheres.

It is easy to understand the economy of an operation which enables us to diminish to one half, the quantity of sulphuric acid necessary for the decomposition of the lime soap.

It appeared to me interesting to subject to an attentive examination a saponification performed with so small a quantity of a base, as one twenty-fourth part of the acidified fatty matter.

I prepared a lime soap by double decomposition by pouring a solution of chloride of calcium into an aqueous solution of commercial soap. The precipitate, when well washed, was introduced into a small Papin's digester, with nearly its own weight of water and 40 per cent. of olive oil. The vessel was kept for nearly three hours in an oil bath at a temperature of from 155° to 165° C. (311° and 329° F.)

The water above the precipitate was evaporated, and left a syrupy residue, presenting all the properties of glycerine.

The precipitate when boiled in water acidulated with hydrochloric acid furnished a completely acidified fatty matter; for it was directly and entirely soluble in alcohol and the alkalies. In one word, the reaction showed all the characters of the ordinary decomposition of the neutral fatty matters by the free alkalies. The difference in hardness of the new lime soap being set aside (it was not so hard), one might

have supposed that the saponification had been performed with caustic lime.

Another experiment was made by mixing Marseilles soap with its weight of water and one quarter of its weight of olive oil. The temperature and operation were the same. The matter, after the reaction, had all the properties of an acid soap: it was soluble in cold alcohol and in an aqueous solution of potassa or soda. Acids separated from it a fatty substance, likewise entirely soluble in cold alcohol and alkaline solutions.

It results from the double experiment which has just been described, that soaps are as capable as alkalies of decomposing fatty bodies into glycerine and fatty acids; it will thus be understood why I have given to this note the apparently paradoxical title of *saponification of neutral fatty matters by soaps*.

I have moreover ascertained that at the temperature of 329° F. (165° C.) water does not act on oils. To decompose them it is necessary that the mixture of fatty matters and water should attain and be maintained for a long time at the temperature of 220° C. (428° F.) assigned by M. Berthelot for this latter saponification.

In England, where Price's house manufactures immense quantities of stearine candles, the saponification is performed by the action of super-heated steam at a still higher temperature. Thence result fatty acids and free glycerine which is nearly pure, and whence arts manufactures, and medicine, have already drawn great advantages which will probably be much increased.

In the new reactions of which we speak, it will be understood that water, at a temperature of from 155° to 165° C. (311° and 329° F.) decomposes a neutral soap, into an acid soap and a very basic soap, and that the latter acts in a secondary manner on a fresh quantity of fatty matter in the same manner that a free alkali would do. The observations of M. Chevreul relative to the action of water on soaps accord with this explanation.

The experiment of M. Milly, which served as a foundation for my work, may be explained in an analogous manner.

It must be admitted that the saponification of suet by means of 4 per cent. of its weight of lime presents several distinct phases in which a basic or neutral soap is formed at first and is then changed into a relatively acid soap.

The observations of which I have been giving a summary find a simple interpretation in M. Chevreul's works on fatty bodies.

They lead us to look forward to fresh developments in this class of numerous and important substances. When the elements of water alone cause the decomposition of neutral fatty bodies into fatty acids and glycerine, we may expect that science and industry will multiply and vary the phenomena of saponification.

I mentioned some months ago* some reactions perhaps even more curious than those of which I now speak; namely, the spontaneous

* See THE CHEMIST, vol. ii., page 469.

saponification of all fatty bodies without exception, without even contact with the air, by the simple mechanical division of the seeds containing them.

Comptes Rendus, No. 23, Dec. 3rd., 1855.

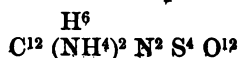
On the PRODUCTS of the DECOMPOSITION of NITROBENZINE and

NITROTOLUINE by SULPHITE of AMMONIA,

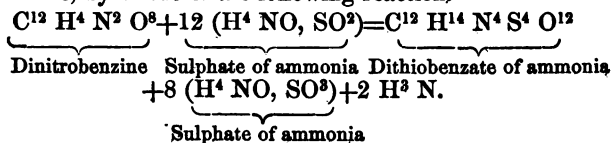
By M. HILKENKAMP.

By the reaction of sulphite of ammonia on nitronaphthaline, M. Piria obtained two isomeric acids, thionaphthamic and naphthionic acids. In the hope of obtaining analogous compounds with nitrogenous derivatives of the hydrocarbons $C^8 H^{10}$, M. Hilkenkamp has examined in M. Will's laboratory, the action of sulphite of ammonia on nitrobenzine and nitrotoluine. These new compounds are found in the following circumstances:—80 grammes of nitrobenzine, probably containing dinitrobenzine, and 340 grammes of solid sulphate of ammonia are put into a large bottle with 1 litre of absolute alcohol. After adding to this mixture some fragments of carbonate of ammonia it is boiled for eight or ten hours, taking care to condense the vapors and to cause them to flow back again. When the reduction is terminated, which is known by a portion of the liquid no longer rendering water turbid, it is allowed to cool. After twenty-four or forty-eight hours, all the sulphite of ammonia will have separated from the liquor. It is filtered and evaporated to a syrupy consistence taking care to add carbonate of ammonia so as to maintain the alkalinity of the liquor. After some time two species of crystals separate, thin soft plates and hard needles.

When these crystals are collected on a filter and pressed between two sheets of paper, the plates disappear with the mother liquor and the needles alone are collected. To purify these they are washed with a mixture of alcohol and ether. A perfectly white crystalline powder is thus obtained, containing $C^{12} H^{14} N^4 S^4 O^{12}$. It is the ammoniacal salt of thiobenzic acid; its rational composition is expressed by:—



It is doubtless formed by the action of the sulphite of ammonia on dinitrobenzine, by virtue of the following reaction,



It is probable that the plates which are formed at the same time as the crystals of which we speak and which were not collected were formed by the action of the sulphite of ammonia on the nitrobenzine itself, and that they contained $C^{12} H^{10} N^2 S^2 O^6$.

However this may be, dithiobenzate of ammonia is a salt which is so soluble in water and in aqueous alcohol that it is impossible to crystallise it from these vehicles. It is sparingly soluble in absolute alcohol and is insoluble in ether. Heated on a sheet of platinum it carbonises and swells up disengaging sulphurous acid. Its aqueous solution has a slight acid reaction. It quickly reduces nitrate of silver and by ebullition transforms corrosive sublimate into calomel.

H^6

To obtain dithiobenzate of baryta, $C^{12} Ba^2 N^2 S^4 O^{12}$, the ammoniacal salt is put into boiling baryta water, and the boiling is kept up as long as ammonia is disengaged. After removing the excess of baryta with carbonic acid the solution is evaporated, and the baryta salt is obtained in the form of crystalline crusts. After dessication *in vacuo*, these crystals are white with a pink tinge.

Sixty grammes of nitrotoluine $C^{14} H^7 NO^4$ were mixed with 400 grammes of a saturated solution of sulphite of ammonia. After adding 1 litre of absolute alcohol and a little solid carbonate of ammonia the whole was boiled for several hours. The operation being finished as before, thin plates were obtained which could be separated from the mother liquor. For this purpose the whole was agitated with ether: the very dense mother liquor separated quickly and the plates remained for some time in suspension. It was decanted, and after separating the crystals rapidly, they were heated to 50° or 60° (122° or $140^\circ F$), and they were dried *in vacuo*. These crystals are the ammoniacal salt of thiotoluic acid $C^{14} H^9 N S^2 O^6$; their composition is expressed

H^8

by the formula $C^{14} NH^4 N S^2 O^6$.

They are thin, silky lamellæ, unalterable in dry air, but which gradually decompose in moist air, assuming a red color. They are insoluble in ether, but dissolve in water and in alcohol. The alcoholic solution saturated hot, deposits crystals by cooling. Nitrate of silver is reduced by a solution of thiotoluate of ammonia. Sesquichloride of iron assumes a purple color with it, and when heated, deposits a black precipitate.

When thiotoluate of ammonia is decomposed by boiling with carbonate of potassa, thiotoluate of potassa is obtained which is separated from the excess of carbonate with absolute alcohol. The alcoholic

H^8

solution gives, by cooling, little lumps which contain $C^{14} K N S^2 O^6$.

This salt is much less alterable in the air than the thiotoluate of ammonia and is less soluble in water and alcohol.

Thiotoluate of soda may be obtained in the same manner, which forms in little lumps when pure, and becomes after dessication a white crystalline powder.

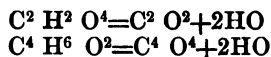
Thiotoluate of baryta forms white crystalline crusts, which much resemble dithiobenzate of baryta.

Annalen der Chemie und Pharmacie.

CONVERSION *of* OXIDE *of* CARBON *into* FORMIC ACID.

By M. BERTHELOT.

OXIDE of carbon presents with regard to formic acid the same relation as olefiant gas does with regard to alcohol. The two gases differ from the corresponding compounds only by the elements of water.



Moreover, oxide of carbon may be obtained by treating formic acid with concentrated sulphuric acid, in the same manner as olefiant gas by means of alcohol.

These resemblances have led me to convert oxide of carbon into formic acid in the same manner as I converted olefiant gas into alcohol.

Only, instead of effecting the fixation of the elements of water by means of sulphuric acid, a substance capable of combining with alcohol, I had recourse to potassa, a substance capable of combining with formic acid.

I operated in the following manner:—

Into a pint flask, 10 grammes of slightly moistened potassa are introduced, and then it is filled with pure carbonic oxide* and sealed in a lamp. Ten or twelve of these flasks are arranged in a water bath and heated to 212° F. (100° C.) for 72 hours. At the end of this time the flasks are opened over mercury, and it is found that a nearly complete vacuum has been produced; the carbonic oxide has been absorbed by the potassa.

The matter contained in the flasks is dissolved in water, supersaturated with sulphuric acid and distilled. The distilled product is treated with carbonate of lead, boiled and filtered: the cooled liquid deposits crystals of formiate of lead.

These crystals possess the normal properties, reactions, and composition: they are especially apt to disengage pure carbonic oxide, at 212° F. (100° C.), in presence of concentrated sulphuric acid.

Comptes Rendus, No. 22, Nov. 26, 1855.

INDUSTRIAL CHEMISTRY.

THEORETICAL SUMMARY *on the* ACTION *of the* ALKALINE SILICATES *in the* PRODUCTION *of* HYDRAULIC LIME, CEMENTS, and SILICIOUS STONES. *Some* GEOLOGICAL CONSIDERATIONS *on their* FORMATION *by the* HUMID WAY *in general*.

By M. KUHLMANN.

Geological Considerations.—I said in 1841:—"When reflecting on this admirable reaction (that which leads to the hardening of calcareous stones by means of silica), are we not naturally led to attribute

* Prepared either by means of oxalic acid, or by means of a mixture of chalk and charcoal.

not only the infiltrations and crystallisations of silica in calcareous rocks, but also the formation of an infinity of natural silicious and aluminous pastes, to analogous reactions? Are we not led to admit that silex, agates, petrified wood, and other silicious infiltrations are of similar origin? that they owe their formation to the slow decomposition of the alkaline silicate by carbonic acid? This is a question which would throw a strong light on the natural history of the globe, and which appears nearly demonstrated by the presence of potassa, which I have found in small quantities in different silicious stones, such as silex, opal of Castellamonte," &c., &c.

My estimations of the intervention of potassa in the formation of mineral species have not been confined to silica and alumina; the presence of potassa ascertained in the crystallised peroxide of manganese, oligist iron, talc, asbestos, emery, emeralds, sulphuret of antimony, sulphuret of molybdenum, &c., have enabled me to assert the possibility of explaining the formation of many of these bodies by the humid way, especially that of the oxides soluble in an excess of potassa. In support of these opinions I may cite the formation by the simple contact of the carbonic acid of the air and by a slow contraction, of masses of silica sufficiently hard to scratch glass, of translucid aluminous pastes, of hydrated oxide of tin of a vitreous appearance, &c.

Such was the state of the question in 1841. Since then I have made many investigations with the view of confirming my former opinions.

As to the formation of silicious pastes, M. Pottier, Commander of the brig *L'Agile*, which has been for a long time stationed at Iceland, has been kind enough to bring me various specimens of silicious deposits, found in the waters of the Geyser. I remarked in these samples, layers of hydrated quartz, which evidently proceed from a slow contraction of silicious molecules exposed to the contact of the air, and other layers of earthy quartz or of opaque porous silica, whose formation may possibly be explained by the various conditions in which the contraction of the silica has taken place; the silicious paste giving sometimes by a gradual and slow retreat, transparent or translucid hydrated quartz, the undulations of which follow the contour of the rock upon which the silica has been deposited, sometimes porous layers due to a too rapid dessication. An attentive observer will easily observe in this succession of layers the effect of the different seasons of the year.

I have tried to vary the phenomena of the precipitation of silica by gradual action, similar to what is produced in nature by the carbonic acid of the air.

The following is a very successful first experiment.

I placed at the bottom of several glass vessels a concentrated solution of silicate of potassa; then, with great precaution, avoiding any mixture of the liquids, I poured over it separately, concentrated nitric, hydrochloric and acetic acids, their density being, however, less than that of the solution of silicate of potassa, so that they might remain upon the silicious solution.

The following results were observed; there was immediately formed

an opaque silicious layer, exactly separating the two liquids; this layer was successively thickened on the side of the silicate of potassa by the addition to the separative pellicle of layers of transparent or translucent silica, and in eight days I had hard and compact silicious layers more than a centimetre in thickness. During this period the acids became more and more nearly saturated with potassa. By operating on layers of silicate of potassa 5 centimetres thick, I transformed it, in less than a month, into semi-transparent and hard silica, the potassa having penetrated the layer of condensed silica as long as the upper pellicle, which served as the origin of this species of silicious vegetation, was in the presence of free acid.

In mentioning this fact I do not wish to enter on the theoretical discussion of the mode of action which is followed, to pronounce whether it is an osmotic phenomenon rendered active by chemical affinities, or whether the various causes of these reactions are the various densities of the liquids, densities which are modified by the reactions themselves; I will merely say that in any case no one can draw an argument in consequence of the heterogeneous nature of the osmotic membrane which commenced the phenomenon.

The silica thus artificially condensed presented the changing aspect of the opal; its preservation in imperfectly dry air would probably enable us to obtain this stone with all its characteristic properties.

This first experiment was soon followed by others. Concentrated sulphuric acid was used, which, by reason of its density occupied the bottom of the glass; the solution of silicate of potassa was carefully poured upon this. The phenomenon of gradual decomposition was again produced, the pellicle which formed thickened on the side of the silicious solution, and the saturation of the sulphuric acid by the potassa manifested itself by the gradual deposition, at the bottom of the glass, of crystals of sulphate of potassa.

Other reacting liquids were also employed. A layer of a solution of hydrochlorate of ammonia was poured on to the silicate of potassa. The silica separated in the same manner and the potassa passed through the silicious layer to substitute itself by degrees for the ammonia, which partly escaped into the air.

Chemical affinity was in this case likewise sufficiently active to produce quickly, a thick, hard layer of silica.

The phenomenon is produced much more slowly when we use less powerful reagents. Thus after proving that chloride of sodium may form a sparingly soluble compound with the alkaline silicates, I poured a solution of common salt on a layer of silicate of potassa, and I found that the white membrane formed at the point of contact thickened very slowly, the action soon stopping. We must add, however, that a layer of alcohol, superposed upon the silicate of potassa gradually removes the alkali, and determines the successive solidification of the silica or of an acid silicate.

I think that these facts, which have a physico-chemical interest, give the key to the formation of natural silicious pastes in circum-

stances where the condensation of the silica is due to other bodies besides carbonic acid.

Extending my examination to the general formation of mineral species by the humid way, I have reproduced the following phenomena by modifying in a hundred ways the agents and methods of action.

Having ascertained that chemical affinities may be exerted through pellicles formed of the principles of one of the reacting bodies, I superposed a great number of solutions of different densities, the mixture of which would lead to precipitation. I thus perceived a multitude of phenomena analogous to those which I have just described, but more general in their character.

In these experiments I operated by the immediate contact of liquids, and when the pellicle formed by the contact was disposed to precipitate itself through the denser liquid, I retained it in its place with a platinum wire or some other unalterable obstacle.

I went still further; removing the natural pellicle, I introduced a porous body between the reacting liquids, unglazed earthenware for example, and I obtained the same results with a great many precipitable matters, and by means of this slow reaction, I have often obtained magnificent crystallisations.

For example, by placing a porous vessel, filled with a solution of acetate of lead, in a bath of hydrochloric acid, the liquids on each side of the porous vessel being on a level, in less than a day the solution of acetate of lead will diminish nearly a centimetre in height, and the vessel containing it will be filled with magnificent needles of chloride of lead; the acetic acid of the acetate will be found mixed with the hydrochloric acid, and after the separation of all the lead, the hydrochloric acid will have penetrated the vessel, which will be filled with crystals. By operating with nitrate of silver or nitrate of protoxide of mercury and hydrochloric acid, the chlorides of silver or mercury are gradually deposited; but in the conditions in which the experiment took place the action was undoubtedly too rapid, for the chloride did not assume the crystalline form.

A fresh attempt was made with nitrate of protoxide of mercury and hydrochloric acid, by operating on larger masses and the chloride crystallised well. By analogous reactions I have prepared phosphate of lime having a crystalline appearance, sulphate of lime, carbonate of zinc, ferrocyanide of copper, &c., The crystalline or amorphous matters were produced sometimes in the metallic solution, sometimes in the solution of the reacting substance. Very considerable changes in the level of the liquid were often produced.

Acetate of lead and nitrate of baryta, separated by porous cells from a bath of sulphuric acid, gave rise to a gradual dense deposit of sulphate of lead, and sulphate of baryta, adhering to the sides of the vessels; the crystalline nature of the latter salt was especially indubitable: with acetate of lead and carbonate of potassa, I obtained carbonate of lead in little lumps adherent to the sides of the porous vessel. I must add that chloride of gold, enclosed in a porous vessel, placed in a bath

of a solution of sulphate of protoxide of iron, or hyposulphite of soda, or finally of oxalic acid, gives rise, after a few days, to the precipitation against the sides of the vessel, of a more or less thick layer of plates of gold with a crystalline appearance.

In several of the reactions attempted I have obtained good results by putting a small necked flask quite full of one of the reacting solutions, neck downwards, in a vessel containing the other solution, so as to avoid the entrance of air. As soon as they come in contact, the neck of the flask is filled with a precipitate due to the partial mixture of the two solutions, then a slow exchange is established between the two liquids through the insoluble mass. Thus, with acetate of lead enclosed in the flask and hydrochloric acid in the other vessel, magnificent crystallisations of chloride of lead are obtained. To avoid a too abundant formation of amorphous chloride of lead, the contact may be retarded by means of a fragment of porous earth, a badly fitting cork, or a little bit of sponge; but it does not do to oppose the contact too much. A thin piece of cork, fixed where the liquids separate, has frequently given me the best results.

In this superposition of liquids, the reactions appear to take place gradually throughout the whole height of the columns, the reaction being propagated through the solutions. Doubtless local changes of density or of temperature due to the reactions themselves will aid in producing these effects. The volume of the liquids often augments; sometimes a species of arborisation in the midst of the liquids precedes the crystallisations.

I poured aerated essence of turpentine on a solution of sulphate of protoxide of iron without interposing any body; basic sulphate of sesquioxide of iron was gradually formed at the point of contact; the reaction soon took place throughout the ferruginous liquid, and the upper part of the essence assumed a reddish color from the solution of a considerable quantity of sesquioxide of iron, one portion of which was precipitated by the ebullition and which might almost be considered as approaching ferric acid. A gradual action then took place from the contact of the aerated essence of turpentine with a solution of sulphurous acid. Sulphuric acid was produced in this case. I even obtained the partial transformation of ammonia into nitric acid by placing a layer of aerated essence upon a solution of ammonia in water.

The reaction of oxalic and tartaric acids on chloride of calcium and acetate of lime gave me crystallised acetate and tartrate of lime. I might mention many other reactions which were successfully produced, but that this would cause me to wander too far from the principal object of this work, which should apply chiefly to the part played by silica in my processes of silicatisation.

When my fresh investigations are complete, some of which require a great deal of time, I shall make them the subject of a special communication, confining myself at present to this summary of some facts, which give us a glimpse of what geology and physiology may discover by following up the line of experimentation which I have commenced.

By varying the temperature, the density of the liquids, the pressure,

the nature of the porous bodies, &c., I hope to be able to reproduce artificially most of the crystallised mineral bodies; and I trust that new facts will soon enable me to explain, more satisfactorily than has hitherto been possible, a portion of the transformations which are accomplished in the organs of vegetables and of animals.

Comptes Rendus, No. 24, Dec. 10, 1855.

*On a NEW PROCESS of PREVENTING ACID VAPORS from ESCAPING
up the CHIMNEYS of CHEMICAL MANUFACTORIES.*

By MM. CH. and AL. TISSIER.

THE process which we apply in this case consists in interposing, between the principal flue and the tall chimney of the manufactory, a species of lime oven, heated by a contiguous furnace, and into which will enter, on the one side, in consequence of the draught, all the vapors from the factory, on the other, the flame of the furnace intended to heat the lime with which the oven is filled, a certain temperature being necessary for the complete absorption of the acid gases. It will be clear that the arrangement of the oven may be varied *ad infinitum*; consequently our process consists essentially in the use of lime or carbonate of lime brought to such a temperature that the absorption shall be as complete as possible, the elevation of the temperature aiding at once the draught of the chimney and the absorption of the acid gases.

This process is used at our manufactory at Amfreville near Rouen, where aluminium is at the present time extracted on a very large scale, and it has given excellent results in stopping the acid vapors produced by the manufacture of chloride of aluminium. It is well known that these vapors, composed of chloride of silicium, chloride of aluminium, chloride of sulphur and hydrochloric acid, are extremely sharp and corrosive, and it is to the interest of all to prevent their escape.

Comptes Rendus, No. 24, Dec. 10th, 1855.

*NOTES on the MANUFACTURE and COST of CHARCOAL for SANITARY
PURPOSES.*

By E. H. DURDEN, F.R.S.

Manufacture of Charcoal in Heaps or Mounds.—This mode of making charcoal, which has been known for 2,000 years, is in use in most parts of the country. When made from wood, a conical heap or mound is carefully built up, and covered with sods of earth. The pile is kindled by means of ignited wood, thrown into the hollow space left in the centre of the mound. In this mode of making charcoal, the expense of conveying the wood to any given locality is saved, the charcoal being made on the spot where the wood is felled. The price of wood and of labor differs so much in various localities, that it is

difficult to give an idea of the average cost of charcoal made in this way. Taking the value of wood on the spot at 6s. per ton, in a tolerably dry state, the cost of such charcoal would, with the addition of labor, be about 33s. per ton *on the spot*. Add to this carriage to a given locality, and expense of grinding, the *actual cost* of the ground charcoal may be estimated at 45s. per ton.

Various methods have been tried for collecting the pyrolignous acid, &c., formed in the process of carbonisation; but it has been found that collecting these products from the mound generally does more damage than it is worth. The charcoal obtained by the above process answers better than any other for metallurgical purposes; but it is doubtful whether it is so well adapted for sanitary purposes as the cylinder-made charcoal.

Peat may also be carbonised in heaps or mounds, in the same way as wood charcoal; although, from the great contraction which peat undergoes when carbonised, difficulties are experienced which do not occur in the case of wood. This mode of carbonisation is adopted in France, Bavaria, Saxony, and Bohemia; and the cost of peat charcoal produced is estimated at 14s. to 16s. 6s. per ton. I have no data as to the probable cost in this country; but, as the quantity of charcoal obtained in Bavaria is equal to 25 per cent. of the weight of the peat employed, I have no doubt it could be manufactured in Ireland at a price equally low.

Manufacture of Charcoal in Iron Cylinders.—This is the mode adopted in the preparation of wood spirit and acetic acid. Large iron retorts, set in brickwork, are filled with wood, and heated externally. Water, wood spirit, acetic acid, tar, &c., pass off in the form of vapor, which is condensed by suitable means, and these various products separated by subsequent distillation. Incondensable gases are also given off. The charcoal, which remains behind in the retorts, is drawn out into iron boxes and cooled. The average annual product, in a large establishment, would not exceed 23 per cent. In this mode of manufacturing charcoal, the cost of the wood is a more expensive item than in the preceding mode, inasmuch as the carriage from the place where it is felled to the works where it is carbonised has to be added to the original cost. The cost of wood delivered at the works varies considerably in different parts of the kingdom; but, taking an average value, and adding thereto the expenses of fuel and labor, and wear and tear of apparatus, the cost of charcoal made in this way would be upwards of £5 per ton. It answers the purpose of the manufacturer of gunpowder to make charcoal in this way, without troubling himself to collect any of the other products, because the charcoal is the most important ingredient in the gunpowder, and the expense of obtaining it, suitable for the purpose required, is comparatively of little importance; but it will not pay to make disinfecting charcoal by this process. The acetic acid and wood spirit obtained, at present enable the manufacturer of cylinder charcoal to carry on his works; but it would not do to multiply such establishments as those for the sake of the charcoal only, as the increased supply of wood spirit—an article at

present of limited consumption, and likely under the operation of the Spirit of Wine Act at the present session to be still more limited—would so much exceed the quantity required for consumption, that the consequent reduction in price necessary to effect sales would speedily close the manufactory. Granulated cylinder charcoal, suitable for sanitary purposes, may be obtained at 35s. to 40s. per ton at the works.

This mode of carbonising peat by the iron cylinder has been tried at Dartmoor, in Devonshire, on a large scale. The experiment, however, was found to be not sufficiently remunerative, and was therefore abandoned. The peat is so light of weight, that a very considerable number of retorts are required for the carbonisation of such a quantity of material as would be worth while to operate on daily: hence a very great outlay in plant is requisite; the labor of charging and discharging is also proportionably great. Much longer time is required for the carbonisation of peat than of wood, and the relative products obtained are not so large in quantity. The commercial working of this process gave the following results:—

Peat employed to furnish the charcoal 100 tons.

Peat required for fuel 100

200 at 2s. 6d. per ton.

Products obtained:—Charcoal, 33 tons; peatine, 100 gallons; heavy oil, 50 gallons; pyroxylic spirit, 30 gallons; acetic acid, 168 gallons; crude tar of the consistence of tallow, 33 cwt. 0 qrs. 14 lbs.; sulphate of ammonia, 7 cwt. 2 qrs. 0 lbs.; peat ashes, 8 tons.

Manufacture of Charcoal from Sawdust, Spent Dye Woods, &c.—Sawdust, spent dye woods, spent bark from the tan pits, &c., are all capable of yielding, by destructive distillation, wood spirit and acetic acid. The carbonisation of these materials was found not to answer in a commercial point of view, on a large scale, whilst using the ordinary iron cylinders; for the sawdust, in close contact with the heated cylinder, becoming carbonised, forms a layer of non-conducting material, presenting a complete barrier to the passage of the heat to the interior of the mass. To obviate this difficulty, the late Mr. Halliday, of Salford, devised and patented the following plan. The raw material is introduced into a hopper, placed above the front end of an ordinary iron cylinder, about fourteen inches in diameter. In this hopper a vertical screw revolves, conveying the material, and in the proper quantities, to the cylinder, which is placed in a horizontal position, and heated by means of a furnace in the usual manner. Another revolving screw or worm keeps the material in the retort in constant agitation, and at the same time moves it forward to the end. During its progress through the cylinder, the material is completely carbonised, and all the volatile products disengaged. At the extreme end of the cylinder two pipes branch off; one passing downwards and dipping into a cistern of water, or an air-tight iron vessel, into which the charcoal falls; the other pipe, passing upwards, conveys the vapors and gases into the condensing apparatus. In Muspratt's *Dictionary of Chemistry*, article

"Acetic Acid," a comparison is given of the quantities of some of the products obtained by this process, as compared with the ordinary cylinder plan. The produce of charcoal of the screw process is not given; but, assuming it to be about 600 lbs. from a ton of sawdust, and putting the cost of the sawdust at 5s. per ton, the cost of such charcoal, including labor, fuel, and other expenses, would be about 40s. per ton. The density of the pyrolignous acid produced, is stated to be 10° Twaddle (specific gravity, 1,050), whilst the density of that obtained by ordinary cylinders is but 6° Twaddle (specific gravity 1,030). We are inclined to believe that this increased density is due to the presence of resinous and other matters, which render a fair comparison obtainable only by comparing the saturating power of the two samples. As the quantity of wood spirit is not given, and as the product in real acid is, we think, erroneously given, we are unable to make a calculation of the actual cost of the charcoal to the manufacturer. It is sold at 40s. per ton.

Manufacture of Charcoal by Sulphuric Acid.—This process is the carrying out, on a commercial scale, of the well known lecture experiment, shewing the composition of woody fibre. A patent has been taken out for this mode of manufacturing charcoal by Mr. Longmaid, who estimates the cost of production at the low price of 12s. per ton. The sawdust is first steeped in dilute sulphuric acid until thoroughly saturated, after which it is exposed, on a kiln or suitable apparatus, to a temperature of about 250° F. when it is found to be completely carbonised. In this case, the product of charcoal is much greater than in either of the other modes, which may be thus accounted for: In the carbonisation of wood, whether in mounds or cylinders, a variety of products are formed, of which carbon forms a constituent. A certain quantity of the carbon originally contained in the wood is therefore consumed in the formation of these products; but in the preparation of sulphuric acid charcoal, only the oxygen and hydrogen of the wood are removed, leaving the whole of the carbon in the state of charcoal. Mr. Longmaid estimates the product of charcoal at, I believe, about 55 per cent. It becomes a question how far this charcoal would answer as a deodoriser. I have not made any experiment on the subject; but I know that Mr. Longmaid looks to this use of it as furnishing a market for its sale.

Manufacture of Peat Charcoal in Furnaces without using Fuel (Mr. Jasper Roger's Patent).—Immediately the blocks are cut from the bog, they are placed in exposed situations, so that the air may circulate freely around and through them, and assist them to drive off the moisture from the peat. Thus, in the course of a short time, according to the state of the weather, it will have become sufficiently dry for conveyance to the drying house, where the remaining moisture is driven off by stacking it against an air-chamber, heated by the surplus heat from the carbonising furnaces.

The carbonising furnaces are of wrought iron, pyramidically shaped, the base measuring about five feet; they run on wheels, and are filled through an opening on the top; the peat is ignited by the introduction

of some burning peat. In the course of a few hours the peat becomes perfectly charred; and the damper attached to the furnace being closed, the charcoal is allowed to cool,

The quantity of charcoal produced from 36,500 tons of peat is 12,166 tons, and the cost of manufacture, as shewn, was 21s. per ton; the selling price in Dublin being 40s. per ton. The cost of the plant required to produce the above quantity, together with the fee simple of the soil, upon which the annual interest has to be calculated, is under £5,000.

Product, 312 tons of charcoal, at 27s. 6d. per ton, or about 19s. on the spot.

Manufacture of Peat Charcoal by means of Super-Heated Steam. This process has been patented by Mr. Vignolles, C.E. The *modus operandi* is as follows. The peat is placed in large sheet iron vessels, into which steam, heated to a temperature of from 450° to 600° Fahr. (by being passed through a coil of pipe heated to that temperature in a furnace), is introduced. The steam, in passing through the mass of peat, gives out its excess of heat, which is sufficient to effect the conversion of the material into charcoal. The above process is a modification of the invention of my friend M. Violette (formerly Commissioner at the French Government Gunpowder Works of Esquerdes, near St. Omer, Pas de Calais) for carbonising wood for the manufacture of gunpowder.

The estimated price (based on the actual cost of an establishment at work at Friesach, in Prussia) is given by M. Vignolles, for an apparatus calculated to produce 11,000 tons of marketable charcoal annually, by means of the super-heated steam process, is 8s. 3d. per ton.

The Dumfries, Glasgow, and Carlisle Peat Company, estimate the cost of a ton of peat charcoal at 16s. 6d.

The Great Peat Working Company of Ireland estimate the cost of a ton of peat charcoal delivered in London at 29s.

Peat charcoal made in heaps or mounds appears to be the best for metallurgical uses, and that made in retorts and furnaces for sanitary purposes.

En resumé, the price of wood, fuel, and labor, varies so much in different localities, that it is impossible to give more than a rough idea of the actual cost of charcoal. The sulphuric acid plan appears the cheapest mode of obtaining charcoal, provided that a sufficient supply of raw material could at all times be readily obtainable at a low price. M. Longmaid proposes to carbonise peat in the same way; in this case, the supply of raw material is inexhaustible, so to speak. Peat charcoal is, however, apt to contain a large quantity of uncarbonized peat. There can be no doubt that the cylinder-made wood charcoal is the best for sanitary purposes. The question of comparative cost will, however, depend on the locality where the charcoal may be required. As regards the metropolis, granulated charcoal may be supplied to the wholesale dealers, at such a price as to enable them to retail it at from 4s. to 5s. per cwt.

Journal of Public Health.

AGRICULTURAL CHEMISTRY.

REPORT on a WORK of M. GEORGES VILLE, the object of which is to prove that the NITROGEN of the ATMOSPHERE is ASSIMILATED in VEGETABLES.

By MM. DUMAS, REGNAULT, PAYEN, DECAISNE, PELIGOT
and CHEVREUL. (Reporter).

(Concluded from page 219.)

VARIOUS CIRCUMSTANCES IN WHICH THE VEGETATION MAY BE AFFECTED
IN AGRICULTURE.

A.—Consideration of the extent of Soil into which the Roots strike.—Has the capacity of the soil, relatively to the roots of the plants which should be developed in it, no influence on this development. We cannot think so when we call to mind the ingenious experiment of Tulle, prescribed for judging of the soil necessary to the development of a plant, an experiment which Duhamel du Monceau found of such importance that he explained it at the commencement of his *Éléments d' Agriculture*.

Let us imagine a row of turnips, the seeds of which had been sown at about 1·33 metres (about 52 inches) distant from each other, in a triangular space forming part of a fallow land, a space which had been carefully dug before the sowing, and the row of turnips divided into two halves. After the development of the turnips they were pulled up, and it was perceived that, starting from the point of the triangle, they increased progressively in size, up to the eighth inclusively, and that from thence to the last, they were equal to the eighth. From this it was concluded that a circle of 1·33m. radius represented the space necessary to the normal development of the turnips, because the middle of the eighth turnip was distant about 000·665 from each of the two larger sides of the triangle of earth dug up, and because the turnips which were developed in a larger circle were not larger than the eighth.

When we have to grow plants, it is not therefore a matter of indifference to know the space necessary for the extension of their roots in order that they may be placed in conditions as favorable as possible to their development.

B.—Consideration of the Atmospherical Medium in which the Plant is developed.—If the mass of a plant is always considerable in relation to the weight of the gaseous particles which are in contact with it, these particles being capable of being renewed are in a situation to furnish to the plant bodies susceptible of contributing to the increase of its weight, such as oxygen, carbonic acid gas, ammoniacal vapors and every other matter susceptible of being assimilated. In this respect the mass of atmosphere which may be renewed with regard to a plant being, so to speak, indefinite, we see how advantageous the condition of this plant in the open atmosphere is to its development.

If, from the consideration of the matter which the aerial medium

in which the plant grows may yield to it to increase its weight, we pass to the examination of the physical influence which this medium may exert on it, we arrive at results which are no less interesting.

1. The open atmosphere in touching the leaf causes the evaporation of a portion of the water of the juices contained in it; hence the sap is concentrated in these organs, which are so necessary to the life of the vegetable, and the transpiration drawing the sap into the leaves favors the action of the roots in extracting the nutritive matter from the soil.

2. The solar light is necessary to vegetable life: it is by its action that they emit oxygen externally, at the same time fixing carbon and the elements of water in order to form proximate principles. But if light has so much efficacy in producing these effects, the plant must not be exposed to too great a heat. Indeed, the atmosphere in motion facilitating the formation of the vapor of water becomes a cause of cooling; besides, it acts also by abstracting heat from the soil, from the stem of the plant and from the leaves, independently of all evaporation. The motion of the atmosphere moderates therefore the action of the solar heat.

3. The wind which agitates the plants is held by many observers, when it is neither too burning nor too drying, to favor vegetation by favoring the play of the tissues constituting the organs of vegetables.

4. Finally if, as some people think, plants exhale matters which may be injurious to them, if not as a poison, at least as impeding the contact of gaseous matters which are useful to them, let us acknowledge that, in this case, the motion of a free atmosphere on the surface of the plant contributes to maintain the vegetation in good condition.

After having stated these facts, it will be easy to show the difference existing between the vegetation of plants placed in ordinary circumstances, and the vegetation of plants placed in limited atmospheres, and this, in the case in which the atmosphere is not renewed, and in that in which it is renewed.

FIRST CASE.—*Vegetation in a limited atmosphere which is not renewed.*

We cause seeds to germinate in sand previously calcined, and afterwards moistened with distilled water containing ashes of the same kind of seed.

Certainly as regards the greater number of the kinds of seeds which may be submitted to this experiment, their germination does not require, in ordinary circumstances, a constantly damp soil, nor one so very wet as it was in the experiment. This great humidity changes also the condition of the soluble saline matter with regard to the plant: for ordinarily the soluble matter reaches the roots only very gradually and in smaller proportion than in the case under consideration.

The germination once being effected, the conditions of the plant in a limited atmosphere are absolutely different from those in which this plant would be found in the open air; for not only is the mass of the gas very small in comparison with that of the plant, but this limited atmosphere is, besides, saturated with aqueous vapor and stagnant.

The smaller the bell glass, the more the developement of the plant is affected.

Hence, if the roots cannot be suitably extended, their function of extracting the soluble aliment is compromised, even when the limited aerial space enables the stem to be developed as it is in ordinary circumstances. But how would it be if this space were as limited as the soil, if it were saturated with aqueous vapor, and if we were obliged, in order to prevent the plant from becoming too much heated, to remove it from the rays of the sun, under the influence of which is operated in the open air the fixation of the carbon of the carbonic acid at the same time as that of the elements of water. We have said, the open air, with its suitable quantity of aqueous vapor, its carbonic acid and other bodies also, acts on vegetation, and as it is always or almost always below extreme humidity, it aids the ascent of the water and the penetration of the manure of the soil into the plant by favoring its transpiration.

As we have said also, the open air is not only useful to the plant from the bodies which constitute it and those which it may hold in the state of vapor or in suspension, but likewise by its volume, which, owing to renewal, may be regarded as infinite, and, in this respect, the open atmosphere furnishes to the plant all that it is capable of furnishing to it, and, besides, owing to this renewal, it prevents the inconveniences which the matters exhaled by the plant might cause.

What happens in a more or less limited and stagnant atmosphere?

The plant very soon exhausts that which it can take up from this atmosphere, and it must be borne in mind that it never absorbs the whole of the elastic fluid in which it has action, just as an animal never consumes all the oxygen of the air which it inspires. For example, Th. de Saussure, in speaking of the aptitude of the cactus for absorbing oxygen, observed that it reaches the degree of saturation only when it is placed in an atmosphere of that gas containing an excess over the quantity necessary for its saturation, so that, this term being reached, the cactus is immersed in oxygen gas, a result analogous to that which occurs with a solid part in contact with the solution of a dissolved body whose affinity for the solid has but little energy. In order that this affinity may be efficacious, the solid must be put in contact with a volume of solution containing a much greater quantity of the dissolved body than that which can combine with the solid. It is only in this condition, for example, that a stuff can take alum from the water which holds that salt in solution.

In this case, the affinity of the solvent for the dissolved body limiting the quantity of this body which unites with the stuff, produces an effect similar to that in which the body absorbed is in the gaseous state, because then the equilibrium is established between the affinity of the body for the gas and the tension of the latter to remain gaseous in the presence of the absorbing body.

These considerations explain why a plant does not grow in a limited atmosphere. For example, Priestly observed that a mint placed in this condition could not be developed; it continued to be developed,

indeed, for some time, but, by perishing gradually, so that the part which had ceased to live, served as nutriment for the part which was developed, but without attaining to the degree of that which had preceded it.

SECOND CASE.—*Vegetation in a limited atmosphere, but which is renewed, and contains more carbonic acid than the atmosphere.*

It was in conformity with the consideration which we have just enunciated, that one of us (M. Regnault), in researches on the respiration of animals which he made in conjunction with M. Reiset, placed the animals experimented on in conditions much more closely approximating to those in which they live in the open air than had previously been done. Thus the results of these observers differ from those which were obtained in circumstances differing from those in which they operated; and it was in a similar manner to this mode of operating that M. Ville in making plants vegetate in limited spaces in which the air was renewed in a suitable manner, has obviated some of the inconveniences which we have just noticed in speaking of the vegetation carried on in limited spaces, in which the atmosphere is stagnant. Not only is the mass of the gaseous particles augmented in M. Ville's apparatus, but the two volumes of carbonic acid and the 98 volumes of air which constitute them exert the most beneficial influence on the vegetation.

One proof of the advantage of this mode of experimenting is, that in a limited atmosphere in which the dried crop is only three times the weight of the seeds, M. Ville obtained, in pot No. 1 of the glass case, in which there was no fixation of nitrogen, a crop, the weight of which was seven times that of the seeds; and it must be borne in mind this experiment is that which gave the worst result.

If the vegetation of plants submitted to experiment in M. Ville's apparatus is not so vigorous as in the open air, if the air in that apparatus is found to be saturated with aqueous vapor, and if it was necessary to moderate with cloths the brightness of the solar light, still we acknowledge that the renewal of the air with the proper proportion of carbonic acid which it contains, besides the aliment which it may furnish to the plants, has the advantage of preserving them from becoming too much heated.

According to the foregoing considerations, the difficulties which the experimenter has to encounter in the investigation of the origin of the nitrogen in vegetables, are of two kinds:—some are presented when wishing to remove from the plant all sources of nitrogen, that of the atmosphere excepted, the plant is exposed to the risk of languishing from the want of nutriment; the others present themselves, on the contrary, in the case in which, wishing to deviate as little as possible from the conditions favorable to vegetation, risk is incurred of the plant deriving nitrogen from other sources than the atmosphere. These difficulties have led the committee to think that in the experiments undertaken for the solution of questions so difficult to treat as that

under consideration, it would have been admirable to make, comparatively with the experiment in which plants vegetated in calcined sand and distilled water, covered by a bell glass in which the air is renewed, a second experiment in every way similar to the first, with the exception of there being no plant in the calcined sand and distilled water; after the experiment, the sand and water of each apparatus should have been examined.

Conclusion :—

The experiment made by M. Ville at the Museum of Natural History, is in conformity with the conclusions which he had drawn from his former works.

Proposition :—

Such researches as those with which M. Ville has been occupied being very expensive, we have the honor of proposing to the Academy to be kind enough to authorise its *Administrative Committee* to pay the expenses of the experiment which has been made at the Museum of Natural History.

This proposition, on being put to the vote by the President, was adopted.

APPENDIX TO THE REPORT.

Letter from M. CLOEZ to M. CHEVREUL.

M. Ville's experiments repeated before the Committee of the Academy of Sciences accidentally required the employment of a much larger quantity of water than had been at first anticipated.

The distilled water employed in the course of the experiments resulted from three distillations made in the laboratory of the Museum; from the commencement 15 litres of each distillation were set aside in a sealed flask, for the analysis which the Committee might think proper to make.

The experiment being ended, the three portions of distilled water which had been set aside were mixed; 12 litres of the mixture were taken, 1 gramme of pure oxalic acid was added, and evaporation was effected at a gentle heat.

The dried residue should contain all the ammonia existing in this water; but, owing to a perfectly accidental circumstance which I learned too late, it might also contain a certain quantity of this alkali, which existed for a long time in the atmosphere of the apartment in which the evaporation was carried on.

I had assisted in the morning in measuring the quantity of water intended for evaporation; the operation had been commenced several hours when I received intelligence that my father was dangerously ill; I requested your permission to absent myself for a few days, and I immediately set out, leaving a laboratory pupil accustomed to manipulations, and on whom I thought I could depend, to superintend the evaporation, in which also M. Ville's assistant, M. Stöesner, assisted.

During my absence the separation of nickel from iron was effected by means of an excess of ammonia. Naturally, a very large quantity

of this alkali was disengaged into the atmosphere of the laboratory, and unquestionably, the *acid distilled* water which was being evaporated at the same time, must have absorbed more or less of it.

The dried residue was nevertheless sent with the other products to M. Peligot for analysis; the quantity of nitrogen found being much greater than that which I had obtained from another portion of distilled water also prepared in the laboratory, I thought that there must have been some error or accident during the evaporation; I held a sort of inquest on the manner in which the operation had been conducted during my absence. I then learned that it had lasted three days, and I knew the circumstances which I have mentioned, to which circumstances undoubtedly is due the excess of nitrogen found by M. Peligot.

At M. Ville's request, I took 10 litres of the water which still remained and I evaporated it myself in the laboratory of the Ecole Polytechnique, taking care to avoid the presence of ammoniacal vapors; I likewise assisted, in M. Ville's private laboratory, in the evaporation of 10 litres of the same water. The operation was rapidly brought to a satisfactory conclusion by the employment of a gas flame.

The residues of these operations were sent, like the foregoing to M. Peligot. They should contain much less nitrogen than was found in the first.

There still remain in the laboratory about 12 litres of the 45 litres set aside. This quantity will be more than sufficient for repeating the analysis, should the Committee consider it necessary to do so.

Note by M. Biot.

In the interesting report which M. Chevreul has just read to the Academy, he has very properly noticed the great influence of the solar light and even of diffused atmospheric light, on the disengagement of oxygen gas by the green leaves of vegetables. This brings to my recollection an experiment which I had occasion to make, during my stay at Formentera, for the prolongation of the meridian, in 1807. In the intervals of leisure which this work allowed me, I occupied myself by analysing the gases contained in the air bladder of fishes living at various depths in the sea.* The oxygen which was necessary for these analyses was furnished to me by leaves of *cactus opuntia*, which I exposed in water to the solar light under bell glasses. It occurred to me one day to expose these leaves in a dark place to light produced by lamps placed in the focus of three large reflecting mirrors which served as the night signals of our great triangulation, and which, united to the

* These experiments are described in the 1st volume of the *Memoires d'Arcueil*, pp. 252 et seq. I joined to it the description of an apparatus which I used for taking water from the sea at great depth, in order to analyse the air which it held in solution, which air was found at the depth of 800 metres (about 875 yards), to contain considerably more oxygen than atmospheric air, but without sensible increase with the depth. These results were afterwards confirmed by Delaroche, in a second voyage made with me. See the *Memoires d'Arcueil*, vol. II., page 487.

number of four or five, were visible with our telescopes at a distance of forty-five leagues. I threw the light of three of these refractors on *cactus* leaves, contained, as usual, in water under a bell glass. The eye could not have borne this light without being blinded. During the hour that the experiment lasted, not a single bubble of gas was disengaged; but when the bell glass was taken into the diffused light, for the sun was not shining, the disengagement of gas took place instantly and with great rapidity. It was not then known that luminous fluxes emanating from various sources are accompanied by an infinity of radiations insensible to the eye, unequally transmissible through transparent bodies, and not equally capable of exciting chemical actions in the substances which absorb them.

Comptes Rendus, No. 19, Nov. 5, 1855.

On the ACTION of SALTPETRE on VEGETATION.

By M. BOUSSINGAULT.

(Continued from page 224.)

Second Experiment.—*Vegetation of the Helianthus in a Sterile Soil, without the addition of Nitrate of Potassa.*

For the purpose of forming a more correct judgement of the effects of the nitre, I determined on a comparative experiment, and on the 10th of May placed two sunflower seeds exactly in the same conditions as those in the first experiment; the same situation, the same soil and the same water. The only difference consisted in the omission of the nitrate of potassa from the substances added to the calcined sand.

After the appearance of the first leaves, vegetation proceeded with extreme slowness. Thus on the 15th June the first leaves were discolored, and each plant, about 6 or 8 centimetres in height, possessed two pale green leaves. At this same time the sunflowers with the nitre had attained 20 centimetres in height.

On the 22nd August, when the plant was removed, the tallest slender stalk was 20 centimetres, the plant had only two very pale colored leaves and three small leaves in a rudimentary state.

After dessiccation the dried plant weighed 0.325 gr.

The analyses of the plant and the soil led to the following results.

	gr.
Nitrogen, in the plant	0.0022
„ in the soil	0.0032
	0.0054
In the seeds, weighing 0.068 gr.	0.0021
Difference	+0.0033

In this experiment the nitrogen acquired during four months vegetation in the open air did not exceed 0.003 gr.

Influence of Nitrate of Soda on Vegetation.

Nitrate of soda being the only nitrate now used in agriculture, it was necessary for me to examine whether its action on vegetation resembled that of nitrate of potassa; the experiments were made on cresses, and for comparison the plants were cultivated in the open air, in the garden soil, and in sand rendered sterile. The seeds were sown on the 21st August 1855, and the plants taken up on the 7th October.

Third Experiment.—*Vegetation of the Cress in a Highly Manured Ground.*

Ten seeds produced ten flowering plants, weighing, when dried, 1·580 gr., namely, sixty-four times the weight of the seeds. The nitrogen acquired in six weeks amounted to 0·053 gr.

Fourth Experiment.—*Vegetation of the Cress in a Sterile Soil.*

Twenty-one seeds were sown in 295 grs. of quartzose sand to which had been added 0·2 gr. of alkaline ash and 1 gr. of washed ashes. After germination the water used was charged with carbonic acid.

Twelve seeds only germinated. The vegetation took place in the open air, sheltered from the rain. The twelve dried plants weighed 0·11 gr., three and a half times the weight of the seed sown.

The estimations were made with soda lime.

The nitrogen of the sand was determined on one third of the matter.

The result was as follows:—

In the plant, nitrogen	gr. 0·0016
In the soil, „	0·0030
	—————
	0·0046
In the seed „	0·0025
	—————
Difference	+0·0021

There was a gain of 2 milligrammes of nitrogen after seven weeks of vegetation, but this number is probably too high. As in a former series of experiments, I had placed some sand and ashes in another flower-pot without sowing any seed in it, and watered the sand regularly with the same water used for the plants. In the same weight of sand in which the cress grew analysis indicated an increase of 0·7 milligr. of nitrogen which can only be attributed to the influence of the air. The surface of this sand showed some green patches occasioned by cryptogamic vegetation which I trust M. Montagne will be kind enough to examine.

Fifth Experiment.—*Vegetation of the Cress under the influence of Nitrate of Soda.*

Into sand, prepared in exactly the same manner as for the fourth experiment, I introduced by degrees 0·216 gr. of nitrate of soda; sixteen seeds, sown on the 21st August produced sixteen extremely vigorous, although not tall plants. The leaves were of a deep green, but not quite so large as those grown in the garden earth. On the 9th

October, when I closed the experiment, each plant had from eight to ten strong leaves.

The dried plants weighed 0·831 gr., twenty-two times the weight of the seeds.

Nitrogen in the dried plant	gr.	
„ in the soil	0·0254	} 0·0842
„ „	0·0088	
Nitrogen in 0·2163 gr. of nitrate	0·0357	} 0·0376
„ in the sixteen seeds	0·0019	
Difference	0·0034	

We thus find in the crop and the soil within about 3 milligr. of the nitrogen of the nitrate; and in the sand we can ascertain the presence of the salt not absorbed by the plant.

The result of these investigations appears to be that the alkaline nitrates act on vegetation with as much promptitude, and perhaps with greater energy than the ammoniacal salts. Thus, in the experiments on the *Helianthus*, made in soils of the same nature, of equal volume, in identical atmospherical conditions, in the open air and watered with the same water, we find that with 1 gramme of nitrate of potassa the plant attained a height of 50 to 75 centimetres, bore a flower, caused more than 1 decigramme of nitrogen to enter into the vegetable albumen and produced a dry matter weighing a hundred and eight times the weight of the seed. The plant fixed about 3 grs. of carbon, that is to say that in three or four months it decomposed and appropriated the base of more than 5 litres of carbonic acid gas.

Now what occurred in the absence of saltpetre? The *Helianthus* scarcely developed itself; its slender stalk bore two or three very pale green leaves; only 3 milligrammes of nitrogen were assimilated; consequently it scarcely contained more nitrogenous tissue than the seed. The dried plants only weighed five times the weight of the seeds, and, after three months of languid vegetation, not more than 4 decilitres of carbonic acid gas had been decomposed.

The results obtained with the cress are not less conclusive. In a sterile soil in the open air, the plant only acquired 2 milligr. of nitrogen; when dried, its weight was only 3 times that of the seed, having assimilated, at the utmost, the carbon of 1 decilitre of carbonic acid, although moistened with water which was saturated with this gas.

A few centigrammes of nitrate of soda changed the whole aspect of this experiment. The plant then became comparable to that developed in the manured soil; it absorbed 25 milligrammes of nitrogen, and, when dried, weighed twenty-two times the seed which produced it. In six the carbon absorbed represented 7 decilitres of carbonic acid gas.

This manifest influence of the nitrates on the development of the vegetable organisation corroborates the opinion expressed in a former Memoir, that the decomposition of carbonic acid gas by the leaves is in some sort subordinate to the previous absorption of a manure acting as farm-yard manure, this may be ammonia, a putrescible organic matter or a nitrate; it suffices that the nitrogen which it contains

should be assimilable, and able to aid in the formation of the nitrogenous tissue of the vegetable.

The demonstration of this fact, that saltpetre has a very favorable action on vegetation, in consequence of its direct absorption and without the addition of substances liable to putrid fermentation, enables us to comprehend why some waters have a very marked influence on meadows even when containing scarcely appreciable traces of ammonia, the fact being that these waters usually contain nitrates which act in a similar manner to ammonia, but better, in the production of the vegetable.

This remark is important ; for in the present state of agriculture we may maintain that the least contestable origin of the fertility of arable soil resides in the irrigation of a field. Thence are concentrated in the crops all the elements disseminated in the air and water, which, after having passed through the organism of animals, pass chiefly into the cultivated ground. Also, whatever be the progress of culture in a country, except in peculiar cases, it will be found that there are meadows of less or greater extent annexed to the soil given up to the plough. The exceptions are only where it is lawful to use the refuse of large cities, or where Peruvian guano or saltpetre are used.

It must be acknowledged that the source of fertilising principles is comprised in very narrow limits and most frequently it does not depend on the cultivator to render it more abundant. He is advised to increase the number of his cattle so as to increase his manure, but this is really to advise him to add to the extent of his meadows, in which that assimilable vegetation is developed which is always giving to the land without taking anything from it. Doubtless cattle are an indispensable medium between the meadow and the farm ; but when, by means of the simplest agricultural calculations, we endeavor to ascertain the real state of the case, we find that in reality this system is not a producer but rather a consumer, of manure. In fact cattle do not, and ought not to return to the manure tank all the fertilising principles which they consume in the stable, because they appropriate a portion of it, and that to the great profit of the breeder.

In consequence of the difficulty, I had almost said, the impossibility now existing of procuring manure, we are led to examine whether it might not be impossible to create them by combining nitrogen and certain salts in combinations which would be usefully assimilable by plants ; and if the solution of a problem whose importance renders it a social question, may appear very far off, still we must not forget that science has already revealed several phenomena which are of such a nature as to prevent our despairing of success.

Thus, in perfectly ascertained conditions, the nitrogen of the air combining with the carbon, enters into the constitution of an alkaline cyanide, which when deposited in the soil, becomes the source of ammoniacal emanations.

Phosphate of lime, so liberally distributed over the surface of the globe, is transformed into one of the most active elements of manure when its affinity is destroyed by chemical means.

The oxygen of the air when subjected to the mysterious transmutation

which forms it into ozone unites with the nitrogen with which it is mixed and constitutes, in contact with an alkali, the most powerful of manures, a nitrate. A process capable of causing a rapid nitrification of the elements of the atmosphere would evidently solve the principal part of the problem. I will add that if, as M. Schönbein admits, ozone is manifested wherever organic matter putrefies in suitably aerated moist earth, it would probably form nitre at the expense of the nitrogen of the air in a soil containing farm-yard manure.

Whatever be its origin, whether produced by the union of the elements of the air, or whether, the result of the slow combustion of organic debris, it is brought by the water, saltpetre undoubtedly adds nitrogenous principles assimilable to the same principles introduced by farm-yard manure. It is by its use combined with that of the ammonia of the atmosphere that we can explain how in rational culture, when we manure parsimoniously and the exhaustion of the soil is rendered slow by a judicious choice of rotation in the crops, the nitrogen of the crops is generally superior in quantity to the nitrogen of the manure.

Rain is truly the vehicle of the ammonia of the atmosphere; but those commit, in my opinion, a manifest error, who reckon the fertilising principles received by the soil, besides the manure, by the volume of rain water which falls on it. This is supposing that a hectare of soil receives no other water than the rain which falls on its surface. Nevertheless waters enter the soil by means of imbibition and infiltration, and even if their origin is the rain, they dissolve and remove with them very useful matters; the greater part contain nitrates, having this advantage over the salts of ammonia, that they remain as fertilising agents even when the water which introduced them into the soil has been dissipated by evaporation.

Notwithstanding the powerful action of the nitrates they cannot be considered complete manures, because in fact they only introduce nitrogen and an alkali; but by associating them with chemically divided phosphate of lime we should probably obtain a compost possessing the qualities of guano with more fixity in the nitrogenous element. Indeed, on one hand guano consists essentially of an intimate mixture of ammoniacal salts and phosphate of lime in a state of division, approaching, if not equalling, the chemical state of division, and on the other, the experiments described in this Memoir show that the alkaline nitrates behave with plants like salts with an ammoniacal base.

During the approaching season I intend to try a mixture of nitrate of soda and phosphate of lime in a state of chemical division, in farming on a large scale; and shall lay the results before the Academy.

Comptes Rendus, No. 21, Nov. 19, 1855.

PHOTOGRAPHY.**NEW PROCESS of PHOTOGRAPHIC ENGRAVING and PRINTING.**

By MM. HARVILLE and PONT.

THE process which we have the honor of submitting to the judgment of the Academy differs perceptibly from all analogous processes hitherto proposed. The heliotype methods of MM. Berri, Saint-Evre, Beuvière, &c., consisted of a black or white varnish or plaster deposited on the surface of a sheet of glass, which was traced with a point, like the varnish for engraving with aqua-fortis. The designs thus produced were then transferred to *positive* paper, by the ordinary photographic processes. But all the compositions used were hard and brittle, or formed such thick layers that the design was much injured. Moreover these methods only produced the effects of aqua-fortis, and could not give the appearance of a crayon drawing, nor washing effects, nor an imitation of pencil or the stump which is so frequently preferred by artists to the tedious work of stippling.

We thought that it would be really useful to enable sketchers to engrave their drawings rapidly on a layer more or less permeable by light, extremely thin and by no means likely to scale off. We have discovered a means of producing a varnish which will give the effects of the stump, washes, &c., and will thus produce all the various kinds of drawings used in the art. The proofs which accompany this note show the ease with which our process gives the various artistic effects.

For the preparation of the sheets of glass to be afterwards traced upon by artists, we cover them with a thin layer of photographic collodion containing a small quantity of iodide of ammonium. The thickness of this layer is regulated by adding more or less alcohol to the solution of nitrated cotton. When the layer on the glass is as thick as we wish it to be, the collodionised plate is put into a bath of water, containing one tenth of acetate of lead. The acetate decomposes, from the action of the iodide of ammonium; insoluble iodide of lead is formed, which is deposited on the glass, and acetate of ammonium remains in solution in the bath. It appears that a certain quantity of oxide or carbonate of lead is produced at the same time, for the layer soon assumes the firm appearance of white lead, rather than the golden yellow color of iodide of lead. The plate when removed from the bath and dried, presents a smooth, white, opaque surface of extreme thinness.

On this the artist traces, with a steel or ivory point, or with the roller of the engraver, the design which he wishes to reproduce. Nothing is easier than the execution of this design; for by placing the glass on a black surface, the marks appear on the white ground as if they were traced on paper with a pen and Indian ink.

When the surface is once engraved, the plate is plunged into a bath of bichromate of potassa (5 of bichromate to 100 of water), which transforms the white lead salt into yellow chromate; it is left to dry and covered with a white transparent varnish, analogous to that used

by photographers to preserve negative images. This done nothing remains but to take the proofs on positive paper, which is done by processes known to everyone.

As for the preparation of the glass for stumping and washed work, it only differs from the above in this, that the glass plate is put into the bichromate of potassa bath, before being drawn on by the artist. A very thin layer of dextrine then gives greater solidity to the surface which has to bear the action of the stump. Washing is performed after a preparatory operation, with the point or the stump, and after having slightly varnished the plates. It is washed with silver white, or chrome yellow, going from shadow to light, instead of from light to shadow, as in ordinary washing.

The value to artists of this kind of engraving is easily perceived, as it allows of retouching and of giving at will, either a white ground or one the color of India paper, or of the papers colored in the pulp, used by artists.

We have had recourse to the transformation of the white layer of lead salt into a yellow layer of chromate, to give more photogenic opacity to the plaster, without augmenting its thickness.

Comptes Rendus, No. 22, November 26th, 1855.

The Abbé Moigno, in transferring this article to the pages of his valuable journal, the *Cosmos*, makes the following observations in reply to an objection raised against the process of MM. Harville and Pont.

An objection has been made to this process, which would materially reduce its merit and importance, if it had any foundation: "Would it not be more simple for the artist to draw his subject on the paper at once in the ordinary manner? He would do it much more quickly and much better; from the drawing thus obtained a negative could be taken in the ordinary manner, from which any number of positives could be obtained, which would be the fac similes of the original." If this were true, if the positives were really exact fac similes of the original drawing of the artist, this would be right, but it is not so, or rather this is the case only with the outlines of the shapes of the drawing. The effects of washings and the stump are very imperfectly rendered; the demi tints and *chiaro-oscuro*, &c., are rarely recognisable. To form a more careful judgment, we compare anew, and with the greatest care, a great number of engravings and designs with the copies made from them by eminent photographers. Well, we can conscientiously say that these were not fac similes, that there was only a general resemblance, but there is neither transparency nor demy tints. We feel that between the hand of the artist and the positive proof, there has been an intermedium which has deprived his work of its natural appearance, the negative produced by light, a negative which is not easily obtained quite perfect and of the precise dimensions of the original. MM. Harville and Pont's process is the only one which produces perfect fac similes, by which the artist finds his hand in all the copies made by the light, from his work, because

there is no intermediate operation between the original and the copy. In this decision we only repeat what may be heard every day from the numerous artists who have used the process and who daily become more numerous, as well as the amateurs who have gladly hailed with pleasure this new method of reproduction. It has decidedly taken a chief place in the art, and must certainly be considered one of the most useful and fertile applications of photography, or rather as a link between photography and art.

Cosmos, No. 25, Dec. 28th, 1855.

On HELIOPLASTICS. By M. POITEVIN.

I.—NEW PROCESS OF PHOTOGRAPHIC ENGRAVING.

THE problem which M. Poitevin has undertaken to solve, and which we consider that he has solved successfully, may be thus expressed: To produce by the action of the light, and without the use of acids or other work, relief and hollows which may be used as plates, either like copper plates or by simple printing; on rollers for printing textile fabrics; as moulds for card or earthenware, &c. He thus describes his processes.

I pour upon any level surface, on a sheet of glass, for example, an uniform layer of a solution of gelatine; the thickness of the layer should vary in accordance with the hollows which are to be obtained; I allow it to dry spontaneously, or I accelerate the dessication with a stove; when the layer is dry, I put it into a concentrated solution of bichromate of potassa or any other bichromate which does not form with gelatine a compound insoluble in water. After an immersion of several minutes' duration in this liquid, I pass the plate quickly through water and leave it again to dry in the dark. This same layer may be prepared by plunging the gelatinised plate in the solution of bichromate of potassa before the dessication of the gelatine, as soon as it has assumed a sufficient consistency by cooling, or when the layer is to be very thin, by mixing the two solutions of gelatine and bichromate of potassa and then pouring the mixture on the plate.

The layer of chromatised gelatine obtained by one of these three manipulations and dried, is either exposed to the action of the light transmitted through the positive or transparent negative which it is intended to reproduce, or placed in the camera, if it is intended to operate from nature and not by contact. The time of exposure varies, be it well understood, according to the thickness of the gelatine layer and the intensity of the light which is to produce the impression.

After the exposure I plunge the plate into water; all the parts which have not been acted on by the light become impregnated with water, swell and produce a perceptible relief on the surface of the plate; whereas the parts affected by the light scarcely become moist, do not rise, and form comparative hollows. These reliefs correspond to the shadows of the drawing, and the hollows, to the lights. I take a mould from the raised gelatine either with plaster or any other plastic matter,

or by means of an electro-galvanic deposition, after having rendered it a conductor by known means.

Let us suppose that we want a plaster cast. As soon as the parts not affected by the light have arrived at their maximum swelling or are in sufficient relief, I pour a solution of proto-sulphate of iron upon the surface of the gelatine; I wash to remove the excess of iron, I surround the design with small lines and I cover it with the plaster tempered very hard; I leave it for a time and then remove the mould. We can thus obtain several accurate copies from one model, taking care between each application of plaster to cleanse the surface of the gelatine with a soft brush and water, to treat it afresh with the solution of proto-sulphate of iron, and to wash it in plenty of water. The solution of iron is not absolutely indispensable, but it has the advantage of giving consistence to the plaster, the fibres of which might otherwise break when the mould was removed.

I then transform the plaster moulds into metallic plates either by the ordinary processes or by those of the electrotype.

By the above method a direct or positive design, photographic or otherwise, gives on gelatine an engraving whose reliefs correspond to the shadows of the negative, and consequently to the lights of the positive or of the object; the plaster mould or the copper plate will consequently give the shadows in relief; and this plate, used in the ordinary typographical way, with the condition of cleansing or hollowing the too wide lights, will give faithful proofs of the object.

The discoveries which M. Poitevin claims in his first patent, dated 26th August 1855, are, 1st.—The production of reliefs and hollows on a sufficiently thick layer of gelatine impregnated with any bichromate, bichromate of potassa, for example, taking advantage, for the production of these inequalities of surface, of the property which unexposed gelatine has of swelling and becoming impregnated with water, whereas the bichromatised gelatine which has been influenced by light does not swell perceptibly: 2nd.—The transferring of these reliefs on gelatine on to plaster, copper, or other metals: 3rd.—The direct galvanoplastic moulding of these engravings on gelatine.

II.—NEW PROCESS OF PHOTOGRAPHIC PRINTING IN FATTY INKS AND OF VARIOUS COLORS, LIQUID OR SOLID, &c.

This second patent is also dated 26th August; it was read at the ministry of agriculture and commerce on the 27th November. The following is the author's own analysis.

To print photographically with fatty ink, on paper, on lithographic stone, on glass, on metal, or on wood, the proof of a design whether photographic or otherwise, I apply on the surface which is to receive the design one or more layers of a mixture of equal volumes of a concentrated solution of albumen or any of its substitutes, fibrine, gum arabic, gelatine, &c.; and a concentrated solution of a chromate or bichromate with an alkaline base, whether earthy or metallic is indifferent, always excepting those whose base would precipitate the or-

ganic matter of the first solution ; I usually employ a concentrated solution of bichromate of potassa. After the dessication of this layer, which may be deposited several times, or even before, if the impression is not to be made by contact, I subject the sensitive surface to the action of light by placing it behind the negative or in the camera ; the time of exposure depends on the brilliancy of the light. After the exposure, I apply to the surface, either with a pledget, roller, or press, a layer of fat ink, either black or colored ; then I wash it either in plenty of water or with a sponge, or I pass a roller moistened with water over the inked surface ; the ink detaches itself from all those parts which have not undergone the action of the light.

If the screen through which the surface has been acted upon is a negative, either photographic or otherwise, a positive proof is obtained ; and if we have acted on a lithographic stone, we can, by inking it, obtain proofs at once, as if the design had been drawn on the stone. If the screen were a positive design, that obtained on the stone would be a negative, because the ink does not adhere to those parts which have been acted on by the light.

To apply different colors photographically, whether liquid or solid, I make an intimate mixture of the color with a concentrated solution of the same organic bodies, albumen, fibrine, gelatine, gum arabic &c., with the addition of an equal volume of bichromate ; I cover the paper or other body which is to receive the color, with a level layer of this mixture. After this layer is dry, I act upon it with light, either direct or diffused, through a negative of the design which it is intended to reproduce ; I then wash with water and a sponge ; the color only adheres to those parts influenced by the light, and in proportion to the amount of light which they have received. Several colors can thus be applied either simultaneously or successively.

The discoveries which M. Poitevin claims in this patent are as follow.

1st. The application of inks or of fatty bodies to surfaces covered with albumen, gum, gelatine, &c., with the addition of any chromate or bichromate by the action of light transmitted through a design, or emitted by an illuminated body, for the purpose of obtaining, after washing all the impressed and insoluble parts with water, an adherent layer of fatty ink or of a fatty body, at the same time that the portion not acted on remains uncolored.

2nd. The application to paper, textile fabrics, earthenware, glass, &c., of different solid or liquid colors, mixed with the bichromatised albumen, gum, gelatine, &c., for the purpose of fixing these colors by the action of light.

The inventions which we have just described are perfectly original ; they have no connexion with Mr. Talbot's processes of engraving, who only employed bichromatised gelatine as a varnish. We have consulted every source which we could, and have never seen any announcement of the properties of chromatised gelatine or other organic body, such as those mentioned and made use of by M. Poitevin. We cannot understand how any one can have represented M. Poitevin's processes as

public property. We must add that they are very beautiful, and these inventions give promise of a brilliant future.

P. S.—M. L'Abbé Moigno says that at the meeting of the French Photographical Society he took very extensive notes to describe the processes for taking positives of photolithography, photographic engraving, and photographic printing on textile fabrics, shown by MM. Emile Rousseau and Musson, processes likewise based on the use of organic matters with the addition of bichromate, and especially of bichromate of ammonia. But when the prestige caused by M. Emile Rousseau's animated manner had passed away; when he was alone with his acquired knowledge and his books; especially when the details of M. Poitevin's discoveries were clearly explained to him, surprise gave way to scruples which must be expressed. The taking of the positives too much resembled the chromatype processes of MM. Mungo Ponton, Hunt, and Testud de Beauregard; the method of photolithography is a modification, a complication of that of M. Poitevin; the photographic engraving recalls Mr. Talbot's too distinctly; and the method of printing textile fabrics has too great an analogy to that of Mr. Smith, of Blackford.

Cosmos, No. 1, January 4th, 1856.

NEW PROCESS of PHOTOGRAPHY on PAPER.

By M. STEPHANE GEOFFRAY.

THE following process is rather an important one: 1st. As being practically interesting, as it gives a paper which, to the advantages of the best ordinary preparations, adds a rapidity as great as that of collodion: 2nd. Because it is the demonstration of a theory which should be understood, a theory which I am anxious to be the first to explain, especially as M. Taupenot acknowledges being as yet unable to do so.

I mentioned a year ago, a paper which I trusted would be sufficiently sensitive to supersede collodion. I have not succeeded in this endeavor, but I can now send a complete process for obtaining proofs on dry paper, rivalling in quickness the proofs on albuminous collodionised glass of M. Taupenot (*See* page 188). In fact, this process is merely an adaptation of M. Taupenot's, an adaptation deduced from a knowledge of the causes of the phenomenon observed by him. These causes, moreover, are demonstrated by the following facts, which will, I think, be found very instructive for photographers in general, as in them will be found a definite explanation of the phenomena of reduction under the action of developing agents.

The following is my process.

Having chosen your paper, prepare it by any process, either with an iodide, bromide, or *chloride*; pass the leaves dry or not according to the preparation used, in the ordinary way through the aceto-nitrate of silver bath; then wash the sensitive papers, and when entirely freed from any aceto-nitrate of silver which may remain after the formation of the iodide of silver, pass them through a bath of ioduretted albumen

or gelatine, hang them up to dry where the dust cannot get to them, and the papers thus prepared may be kept dry until the day when they are likely to be wanted. Their sensitiveness is then renewed with aceto-nitrate of silver; wash them five or six times; dry again, when nearly dry, paste the edges carefully on a sheet of glass, thick varnished card, or varnished wood, and leave them to stretch. They are then ready for the camera.

The exposure to the light should not last more than 15 or 25 minutes in the shade, and in the sun only 5 or 10 minutes, with an objective of 65 centimetres focus.

I develop the image with gallic acid in the ordinary way. I strengthen the shadows, as usual, with a little aceto-nitrate of silver, and fix with hyposulphite of soda.

This process, intelligently used, is not much more complicated than the ordinary processes, especially to those who have been accustomed to ameliorate their paper themselves, according to the means which I have before explained.

Thus, my ioduretted ameliorating mixtures of 2 or 1 per cent. according to circumstances, form the first layer which I require. The preparation of iodide of starch gives a perfect layer without any addition of iodide; I have here, consequently, only one new operation, rendering it sensitive naturally with nitrate of silver.

I have observed that the first layer might be ioduretted, bromuretted, or *chloruretted*, consequently, it might be chloride of silver which does not allow of continuation with gallic acid, or a bromide of silver which does not do well with it, or an iodide of silver, which does much better with the agents hitherto in use.

Moreover, according as the primary layer is not *continuable*, but is sensitive to light (it is of very little consequence whether the reagents will reach it or act upon it), the more rapid the paper will be. Thus chloride of silver gives the most rapid papers, although it does not *continue*. In fact, it must be remembered that the action of the developing agents is only necessary on one layer, and is produced on the upper layer, which must always be rendered sensitive with an *iodide* of silver. We observe too, that, if the preparation for the last layer is opaque, if it does not permit the passage of the luminous rays, the paper on the glass, even when collodionised will have no more sensitiveness than a paper or a glass covered with a thick layer of iodide of silver as in the known processes.

The upper layer should consequently be a translucent body, permitting the chemical rays to traverse it at once, so as to act simultaneously on the upper and under layers. It is this phenomenon of the simultaneousness of the two reductions by light in the upper and under layers which is the secret of the rapidity of albuminous collodionised glass. This is why I have succeeded on paper with a primary layer of starch or any other preparation, as well as on collodionised glass; with a primary layer of *chloride* of silver as with one of *iodide* of silver.

I have not forgotten the existence of an image on the primary layer, even when latent, for, having carefully dissolved the albumen which

formed the upper layer of one of my sheets, and having thus uncovered the primary layer on which I could perceive no image, even with a lens, on treating the sheet by the known process for *strengthening*, I thus reduced sufficient nitrate of silver to give a *complete sketch* of the image which had obtained on the upper layer.

In M. Taupenot's process, as well as in mine, the rapidity of the result depends on *the catalytic reaction of the image formed on the primary or under layer* which aids the light in reducing the upper layer.

The reduction of the primary layer is to the upper layer, to reduce its iodide of silver under the influence of the chemical rays, what in the ordinary processes the only just apparent image is to the nitrate of silver, added to the gallic acid bath, under the influence of that developing agent.

It has been observed a thousand times that a fixed and well washed image, whether on chloride of silver, or bromide or iodide of silver, may be strengthened with nitrate of silver, after passing through an ioduretted bath; and that with the help of light.

Cosmos, No. 2, January 8th, 1856.

PHOTOGRAPHY on ALBUMENISED and COLLODIONISED GLASS.

By M. F. MARTENS.

(*Supplement to the Note Page 241.*)

IN the fear of making the description of my processes too long I have omitted several observations which are very important to those who wish to use them. Thus, in saying so much to each white of egg I should have mentioned that there are very large eggs which contain a great amount of albumen and a very small yolk, whilst others contain comparatively little albumen. In this last case 1 gramme of iodide of ammonia to each white of egg would be too much; if the ammonia has become of so deep a red as to be almost black from the iodine, less must be put than when it has only been slightly reddened. A little bromide of potassium should be added for landscapes; however, I do not think that very indispensable, not having observed much difference when this preparation is without this salt.

Fixing the Negative on Albumenised Glass.—After the image is developed it is washed in a good deal of water, and the plate is put into the dark, to be fixed afterwards. This is prudent because the layer of albumen, in drying again, would afterwards resist the different immersions. The next day the plates are taken and put one by one into a fresh bath of about 80 grammes of hyposulphite to 100 of water. The light then shews the yellow tint disappear, often in patches; the plate is then removed for examination as a transparency, and when the yellow tinge disappears by degrees, letting it soak for some time (from half to three quarters of an hour), when it is allowed to dry in a sloping condition.

In taking positives there are different methods of operating so as to obtain various tints. At the *Exposition Universelle* I showed proofs of

different tints, on the back of which I marked the various manners of fixing, so as to ascertain the effect produced by six months' exposure; all but one remained uninjured; this one had been put only into an old hyposulphite bath. All those which had been in a fresh bath resisted the action of time; I had only run the risk with one, for I had no confidence in the old baths, which are good for changing the tones, but not to be depended upon. If they are used the proof should likewise be passed through a new bath either first or afterwards.

Fixing the Positive Proofs.—This is very important, and I beg to be permitted to give a very short description of it. The paper first prepared with a salt and then nitrated in the ordinary manner, should be perfectly dry; otherwise it might spoil the negative with which it is put in contact. It is always well to prolong the exposure so that the proof may not become weakened by the various baths. The proof is put into a bath of distilled water for about a quarter of an hour; then it is put into a new bath of hyposulphite of soda of 10 per cent. in which it remains an hour; it is then put into an old bath of hyposulphite, in which it changes color rapidly; from red it becomes a deep brown sepia color; if prolonged, it becomes black, but then yellow, and finishes by weakening and being lost.

If the proof is put, after being removed from the water, into a bath of yellow chloride of gold acidulated with hydrochloric acid, it soon assumes a violet tint, then blue; it must be watched and moved about, and, as soon as it has assumed the desired tint, plunged quickly in common water, washed several times, then put for at least an hour in a fresh hyposulphite bath; but, for this method of operating, as mentioned in M. G. Legray's pamphlet, a more prolonged exposure is necessary, until the dark parts are metallised. If, on the contrary, a proof is put into this same gold bath which has been previously fixed in a bath of simple hyposulphite, and well washed, it will assume a very rich warm sepia tint.

By putting a little of Gelis and Fordos' salt of gold into the hyposulphite, equally fine tones will be obtained; but whatever process is used to fix the positive proofs the most essential point is to make sure that every trace of hyposulphite is removed from the paper, for if the least particle remains the proof will fade with time. It is very bad to put many proofs together in water to remove the hyposulphite, for they stick to each and retain the salt. They must float in plenty of water, and it is necessary to change the water several times and then to put them into a small cistern, containing tepid water, and then into another for several hours. An excellent plan is to have a large box crossed with wires on which the proof can be suspended so as not to touch each other; at the bottom of the box may be a small tap so as to let out the water charged with the salt, while a reservoir of water with a tap of the same size keeps the box always full. The proofs are thus kept constantly washed, the water being constantly renewed while the salt sinks to the bottom. The operation thus requires no attention.

I have remarked that gelatinised proofs keep very well, and those on albumenised paper not so well; this is doubtless because the proof on albumen requires a more prolonged washing.

It is necessary to guard against pasting the proofs on card or Bristol board with common commercial size; they would lose their color very soon. There is no risk in using gum-arabic or dextrine: besides this, photographs must always be kept in a dry place, as the damp would deteriorate them very quickly.

Comptes Rendus, No. 24, December 10th, 1855.

On a NEGATIVE SILVER BATH for COLLODION.

By M. BELLOC.

OPERATORS do not agree as to the strength of the silver bath intended to render collodion sensitive; some have gone so far as to recommend 30 per cent. for this bath, and a journal of Photography has inserted the monstrous process. Evidently, neither the operator nor the journalist had made an experiment with such a solution, for they would have seen iodide of silver formed instantly on contact with the bath, and as instantly disappear, under the influence of its solvent action.

The quantity of 8 or 10 per cent. has been more generally adopted for negative baths; although this quantity is not extravagant, we think that it would be a mistake to compose all baths indiscriminately of this quantity.

No one is ignorant of the effects of a new bath on the first few plates; but people do not seem to be aware that the weaker the bath the sooner it gives good results. From this we conclude, and without fear of mistake:—

1st. That we ought to make a very small quantity of bath at first, just sufficient to dip the plate into, and the bath should be in the proportion of 3, or, at most, 5 per cent. 2nd. That after seven or eight plates have been rendered sensitive, the bath having given excellent results, it must have about an equal quantity of water, containing 6 or 7 per cent. of melted nitrate of silver in it. 3rd. This addition must be repeated as often as the diminished bath requires freshening.

But this bath ages more or less rapidly, not only because of the silver removed chemically by each plate, but also because of circumstances which are independent of this operation. A badly cleaned plate, a drop of hyposulphite or of pyrogallie acid, &c.; are an incessant cause of decomposition, and suffice to produce a rapid change in its chemical composition. On another hand, the operator is well aware of its disturbing causes, and the appearance of the plates soon shows the presence of a foreign substance.

When the bath has aged from long use, the plate is a long time losing its oily appearance; sometimes after having remained in the bath longer than should be necessary, the plate, when exposed in the camera, only produces an indifferent proof with too much contrast between the lights and shadows. And the image appears to be upon a ground of perpendicular lines. The bath has then become unfit for use notwithstanding frequent additions; aldehyde has formed in it: a little hydrosulphuric acid will separate the aldehyde from the silver,

after it has been precipitated; but the old baths contain many things, and analysis seldom finds much silver. It is consequently better to put it with the residues, and to make a new bath with the small proportion of nitrate of silver, which we have already pointed out.

Cosmos, No. 25, December 28th, 1855.

PHYSICS.

On the HEAT PRODUCED by the INFLUENCE of the MAGNET on BODIES in MOTION.

By M. LEON FOUCAULT.

IN 1824, M. Arago observed the remarkable fact of the attraction of the magnetic needle by conducting bodies in motion. The phenomenon appeared singular; it remained unaccounted for, until Faraday announced the important discovery of induced currents. From that time it was proved that in Arago's experiment motion gave rise to currents, which, reacting on the magnet, tended to associate with it the mobile body and to attract it in the same direction. It may be said, generally, that the magnet and the conducting body tend, by mental influence, towards relative repose.

If, notwithstanding this influence, it be desired that the motion should continue, a certain amount of labor must be bestowed upon it, the moveable part seems to be restrained, and this work necessarily produces a dynamic effect which I have thought, according to the new doctrines, must be attributed to heat.

We arrive at the same conclusion by observing the induced currents which follow in the interior of the body in motion; but this mode of considering things could give only with great trouble an idea of the quantity of heat produced, whilst by considering this character as due to a transformation of work, it appeared to me certain that we should easily produce in a decisive experiment a considerable elevation of temperature.

Having at hand everything necessary for a prompt verification, I proceeded as follows:—

Between the poles of a powerful electro-magnet, I partially engaged the solid of revolution belonging to the rotatory apparatus which I have called a *gyroscope*, and which I had previously used in experiment of quite another nature. This solid was a tase of bronze connected by means of a toothed pinion to a moving wheelwork, and which, turned by means of a handle, may attain the speed of 150 to 200 turns per second. To render the action of the magnet more efficacious, two pieces of soft iron superadded to the bobbins prolong the metallic poles and concentrate them in the vicinity of the turning body.

When the apparatus is at full speed, the current of six Bunsen elements directed into the electro-magnet, arrests the motion in a few seconds, as if an invisible bridle had been applied to the motive power; this is Arago's experiment developed by Faraday. But if we then strain at the handle, in order to restore to the apparatus the motion

which it had lost, the resistance experienced, compels us to exert a certain degree of force, the equivalent of which reappears and is effectively accumulated in heat, in the interior of the turning body.

By means of a thermometer buried in the mass, we follow step by step the progress in elevation of temperature. Having taken, for example, the apparatus at the surrounding temperature of 16° C. (60° 8' F.), I saw the thermometer rise gradually to 20° C. (68° F.) 25° C. (77° F.) 30° C. (86° F.) and 34° C. (93° 2' F.); but the phenomenon was so much developed as not to require the employment of thermometrical instruments; the heat produced had become sensible to the hand.

A few days afterwards, the battery being reduced to two elements, a flat disc formed of red copper was raised in two minutes' action to the temperature of 60° C. (140° F.)

If this experiment appears interesting, it will be easy to arrange an apparatus for fully developing the phenomenon which I have noticed. Undoubtedly, by a suitably constructed machine composed only of permanent magnets we may produce elevated temperatures, and exhibit to the public assembled in lecture theatres, a curious example of the conversion of labor into heat.

Annales de Chimie et de Physique, November, 1855.

MATERIA MEDICA, PHARMACY, AND THERAPEUTICS.

On WOOD OIL, a SUBSTITUTE for COPAIBA.

By DANIEL HANBURY.

AMONG the drugs that have recently appeared in the London market, I have observed one article to which I am desirous of drawing attention. It is a liquid imported in considerable quantity from Moulmein in Burmah, and offered for sale under the name of *Balsam Capivi*, but known in India as *Wood Oil* or *Gurgun Balsam*.

To Balsam of Copaiba, however, it presents so remarkable a resemblance, that, but for the locality from which it is imported, it would hardly have been noticed as anything else than Copaiba of rather unusually dark color.

In the Paris Universal Exhibition there are two samples of a similar liquid, labelled *Wood Oil*, one of them being sent among the *Materia Medica* of Canara, the other from the Tenasserim provinces. Through the kindness of Dr. Royle, specimens of each have been placed at my disposal. Though comparatively a new drug in English trade, *Wood Oil* is an article of common occurrence in the bazaars of India.

From its similarity to Copaiba, it might be supposed to have its origin in some plant nearly allied to *Cupaijera*: such, however, is not the case, it being the produce of the natural order *Dipterocarpeæ*.

The following is Roxburgh's account of the manner of obtaining it from *Dipterocarpus turbinatus*, an immense tree, native of Chittagong, Tipperah, Pegue, and other places to the eastward of Bengal.*

* *Flora Indica* (ed. Carey) Vol. ii. p. 613.

"This tree is famous over all the Eastern parts of India and the Malay Islands, on account of its yielding a thin liquid balsam, commonly called *Wood Oil*, which is much used for painting ships, houses, &c.

"To procure the balsam, a large notch is cut into the trunk of the tree, near the earth (say about 30 inches from the ground), where a fire is kept up until the wound is charred, soon after which the liquid begins to ooze out. A small gutter is cut in the wood to conduct the liquid into a vessel placed to receive it. The average produce of the best trees during the season, is said to be sometimes 40 gallons. It is found necessary, every 3 or 4 weeks, to cut off the old charred surfaces and burn it afresh; in large healthy trees abounding in balsam, they even cut a second notch in some other part of the tree, and char it as the first.

"These operations are performed during the months of November, December, January and February. Should any of the trees appear sickly the following season, one or more years' respite is given them."

The same author also states that Wood Oil is afforded by *D. costatus* (*D. angustifolius* W. et A.), *D. alatus* Roxb. and *D. incanus* Roxb., the last mentioned being reputed to furnish the largest proportion of the best sort.

Closely allied to the Wood Oil of *Dipterocarpus* is the oleo-resin termed *Camphor Oil*, produced by *Dryobalanops Camphora* Colebr., a tree of the same natural order. For a specimen of this oleo-resin and of an analogous liquid called *Lagam Oil*, both brought from Sumatra by Dr. Junghuhn, I am indebted to the courtesy of Dr. J. E. De Vrij of Rotterdam.

Wood Oil, as imported from Moulmein, is, after filtration, a transparent, dark brown liquid, of somewhat greater consistence than Olive Oil, a sp. gr. of .964 and an odor and taste like copaiba, though perhaps hardly so strong. One part of it treated with two parts of alcohol sp. gr. .796, is dissolved, with the exception of a minute quantity of darkish flocculent matter, which subsides upon repose.

But its most curious property (as noticed by Mr. Charles Lowe with reference to a liquid which I suppose to have been *Wood Oil**) is that exhibited when it is heated in a *corked* vial to about 266° F. (130° C.).† Thus treated, it becomes slightly turbid, and so gelatinous that the vial may be inverted, even while hot, without its contents being displaced; and on cooling, the solidification is still more complete. Gentle warmth and agitation restore to a great extent its fluidity, but solidification is again produced upon the liquid being heated to 266°. Copaiba displays no such phenomenon.

According to Dr. O'Shaughnessy, when Wood Oil is heated in a retort, a yellowish white, *crystallizable*, solid substance, having many of the properties of benzoic acid sublimes into the upper part of the vessel, to the extent of about one per cent. of the Wood Oil taken. In my own experiments, I have not detected any of this substance. It is true that when Wood Oil is heated, a scanty, opaque white sublimate condenses in the cooler part of the vessel, but this appears to arise from the condensation of a little water among the minute drops of essential

* On a new variety of Balsam of Copaiba—*Pharmaceutical Journal*, vol. xiv. pp. 65, 66.

† Mr. Lowe says 230° F., but a much more striking effect is produced on the *Wood Oil* by the temperature I have named.

oil, since it is not produced if the Wood Oil has been previously agitated with some fragments of dried chloride of calcium.

With regard to its medicinal properties, there appears to be no doubt from an extensive set of experiments instituted by Dr. O'Shaugnessy, confirmed by trials made by other practitioners in India, that Wood Oil is nearly equally efficient with Copaiba, in the diseases in which that drug is indicated.* It may be administered as an emulsion, or in pills made up with magnesia. Dr. O'Shaugnessy has used the essential oil in doses of from 10 to 30 drops.

From the close similarity of Wood Oil to Copaiba, a mixture of the two may be anticipated; from pure Copaiba, such a mixture will probably be detected by a difference of its optical properties.

REMOVAL of METALS from the SYSTEM by GALVANISM.

By G. HUFF, M. D., Lexington, Kentucky.

HAVING experienced the beneficial effects of galvanism in extracting metals from the human body, and, believing it to be a subject of interest to the profession, I hasten to publish a report of my experiments.

CASE I.—Mrs. W. —, aged 27 years, of lymphatic temperament, with auburn hair and white skin, had been under treatment for diseased spine fifteen months. During this time she had taken very large quantities of mercury, which, her subsequent medical attendant stated, produced paralysis of the lower extremities.

I was called in consultation by the advice of her physicians, and it was decided that she should be put under treatment by galvanism. Her physicians having thrown upon me the entire responsibility of the case, I took charge of her; and one day, while making an application of this potent agent to the spine, the feet having been placed in a metallic bathing-tub with acidulated water, her husband suddenly called my attention, exclaiming at the same time, "See the mercury!" On making an examination, I found several globules of metallic mercury lying on the bottom of the tub. I continued this (electric) treatment a long time, and she ultimately recovered, and now enjoys the powers of locomotion most perfectly.

CASE II.—Mr. B.—, aged 40 years, of nervous temperament, with dark hair, white and thin skin, had been treated for syphilis for a long period, and had been repeatedly salivated, from which he had suffered severely in the joints. The capsular ligament was so much elongated as to cause luxation of the head of the *femur*; separation of the *carpus* of each hand had taken place, and the metacarpal joints of the fingers were very much enlarged. He had been under treatment of physicians who stood deservedly high in the profession, and had visited warm springs in Arkansas by their advice. At this time he could scarcely move with crutches, even with the help of two attendants whom he took with him. He remained there one winter, and returned without having obtained any relief. His friends then advised him to

* *Bengal Dispensatory* (1842), pp. 222-224.

apply to me, and with the consent of his physicians, he did so. On examination of his case I concluded to treat him, and commenced with warm baths, which invariably left him worse, the joints becoming more stiff and painful, and with less mobility. Believing that the remote cause of this aggravation of his disease was the presence of mercury in his system, I was induced to attempt to extract it. To accomplish this, after having placed him in a porcelain bathing-foot tub, with acidulated water, and a metallic plate beneath his feet, I completed the circuit, and after the lapse of twenty minutes I discovered a light-white precipitate, and the impress of his toes left on the plate of a light bluish color, with silvery lustre. I repeated this operation several times, and then commenced the galvanic treatment for rheumatism, and infused iodine into the joints in order to produce absorption of abnormal secretion that had formed there. From this time he commenced to improve, and went on improving without a relapse. All the joints have now recovered their normal condition, with the exception of the left hip-joint, the femur of that side now remaining seven-eighths of an inch below the right, although it has ascended three-eighths of an inch during my treatment; his general health has very much improved; in fact, he says it is now as good as it has been at any period of his life.

CASE III.—Mrs. N——, aged 28 years, of bilious temperament, small size, hair and eyes black, of a very high order of intellect. At the birth of her second child there was very profuse hæmorrhage, and much inflammation of the uterus was superadded in consequence of medicines having imprudently been given by her physicians to facilitate labor. For the purpose of suppressing the hæmorrhage and restoring the uterus to a healthy condition, sugar of lead was given in small doses, and its use continued a long time. This treatment resulted in *lead palsy* (the total loss of muscular contraction of the extremities). In order to extract the lead from her system, I commenced the treatment by galvanism in the same manner as in the foregoing case, and with the same results, except that the precipitate was of a dark grey color, and the impress of the toes left on the plate was of a darker hue. When the paralysis was nearly removed, partial amaurosis set in, and ultimately become total. I treated this without benefit, although I think the treatment has not been fully tested, as she was obliged to return home, in consequence of domestic cares, sooner than I anticipated.

Medical Examiner.

MISCELLANEA.

On the INJURIOUS EFFECTS of CEDAR WOOD DRAWERS.

By Dr. JOHN FLEMING, Professor of Natural Science, New College, Edinburgh. (Read before the Royal Physical Society, 11th Dec., 1852.)

WHEN looking over the conchological collection of Lady Agnew,

my attention was particularly attracted to the epidermis of several specimens. Its texture was in appearance changed on certain portions of the surface, and rendered so sticky as to suggest the idea that a coating of dissolved caoutchouc had been applied. On my expressing surprise at an appearance then new to me, her ladyship stated that Dr. Greville attributed the change which the epidermis had undergone to the influence of the cedar wood of a cabinet in which the shells had been kept. I lost no time in consulting my esteemed friend on the subject, and found that he had been a sufferer to some extent from having employed Havannah cedar as a material for the drawers of a cabinet.

Having been myself entirely ignorant of this pernicious property of cedar wood, and finding, from conversation with several friends who were collectors, that its harmlessness was not suspected, I determined to make further inquiry; and I now lay the results before the Society, in the belief that the subject is one with which every professor of specimens in natural history should be acquainted.

The experience of Mr. Bryson, the possessor of the valuable collection of the late Mr. Nicol, could not furnish me with any illustrative facts; but he pointed out to me some valuable notices in the "Minutes of the Proceedings of the Institution of Civil Engineers, 27th April 1847," in connection with the reading of a paper by Charles Frodsham, Ass. Inst. C.E., "On the Laws of Isochronism of the Balance-Spring as connected with the Higher Order of Adjustments of Watches and Chronometers," Mr. Villiamy mentioned the following circumstance:—"His Majesty George the III. was in the habit of having small articles of cabinet-work made at the Royal Observatory, Kew Gardens. The drawers of one of these were made of cedar wood; and in them several watches were placed, with the intention of keeping them going. In a very short time they all came to rest. The experiment was, however, repeated, but with the same result; and on examining the watches, the oil was found to have been completely changed into a substance resembling gum."—Vol. vi. p. 247. Afterwards Mr. Farey stated "that he had observed, many years ago, that cedar wood was unfit for cases in which delicate objects were to be kept. The late Mr. William Strutt, of Derby, showed him a small collection of the minerals of Derbyshire, part of which had been locked up in a new cabinet with close fitting cedar wood drawers. On opening them for the first time after some months, the minerals were found covered with a gummy matter, having a strong odor of cedar, and which was troublesome to remove; it gave to the bright surface of the crystals the appearance of having been varnished in an irregular and unskilful manner. It was obvious that the cedar had emitted a vapor which had become condensed upon the surface of the minerals, and the same would no doubt have happened with watches, or other articles of metal. Whether other wood, such as deal, would have the same effect, should be inquired into." Vol. vi. p. 248.

Shortly after gaining the information now recorded, I had a conversation with Lady Harvey on the subject, who, as possessing a varied

and extensive collection, I conjectured might furnish me with additional particulars. The following memoranda have in consequence been kindly communicated to me:—

“In 1819, Sir John Harvey brought from Bermuda some logs of cedar, which he soon after had made into a bedstead with turned posts. In 1842, Lady Harvey removed to Edinburgh from the Oake, Upper Deal. The bedstead was removed, but the person who took it down had great difficulty in removing the screws, as they were so corroded by the gum that came from the cedar. It was put up again in Edinburgh immediately after: it still retains its smell, but the post next the fire has still a good deal of the gum attached to it, which has become hard. A young friend of Lady Harvey’s, now the Marchioness of Hastings, had a little cedar cabinet in which were some minerals; she found some of them spoiled, in the crystals being covered with a substance which would not come off. The late Sir Thomas Troubridge had also many materials spoiled by being kept in cedar drawers, from the same thing. It was mostly the earthy minerals that were affected; only a few of the metallic ones.”

Accidentally meeting my respected friend Alexander Thompson, Esq. of Banchory, and the possessor of an extensive valuable collection of various objects in the arts of natural history, I ascertained that his experience as to cedar wood confirmed the results of all my previous inquiries; and he kindly complied with my request, in furnishing me with the following statement:—

“*Banchory House, by Aberdeen,*
17th November, 1852.

“My dear Sir,—You asked me to give a memorandum of my experience of cedar wood as a cabinet.

“About ten years ago I received from Halifax several roots of cedar tree, said to be *very* beautiful. I had one cut up in one-fourth and half-inch boards, and made a small cabinet of it, with ten shallow drawers.

“I put a parcel of coins and medals into one of them, and a few months after I was much surprised on opening the cabinet to look at the coins, to find here and there *one* to all appearance *deliquescing*, of course, on examination, it immediately appeared that it was a deposit on the coin, and on taking them up they stuck fast to the fingers, as if covered by a very thick gum-arabic. I was much struck by this fact, viz., it was only *here* and *there* a coin that was affected,—not in groups or in rows,—and copper and silver equally; gold apparently less affected; but then there were comparatively few of that metal. The small drawers are made entirely of cedar.

“In one of the drawers I had laid a few microscopic objects, mounted in Canada Balsam. On taking them out (after some months’ absence) I was amazed to find the Canada Balsam in a fluid state, and the covers of thin glass loose, and two or three slips of fossil wood entirely detached from the glass, which, when put aside, were as firm as Canada Balsam could be. The cabinet stood near a fire-place, and was occasionally *warm*, but not steadily so.

"Notwithstanding what had happened, it never occurred to me that the cedar was particularly to blame, but rather its having been occasionally made very warm, but when there was a larger fire than usual in the room.

"We resolved, therefore, to empty it of its contents, clean it all thoroughly, and remove it permanently to other quarters, where it would not be exposed to occasional heat; and, unfortunately we also resolved to devote it to holding a collection of Roman casts in plaster of Paris.

"On looking at them one day, after they had been perhaps two years in the drawers, we found, as with the coins, here and there one changed from *white* to *brown*, and the whole set nearly ruined.

"I was now fully satisfied that the cedar wood was the culprit, but not till too late to save my casts.

"I have just looked at the whole cabinet. The exterior, where polished and varnished, is all right; and the brass hinges are covered by a gummy deposit, and the whole unpolished drawers, &c., are as sticky as possible; and where there are small *knots* in the wood there are minute drops of gum, and the lock works so stiffly, that I think it must be *filled* with gum on the wards;—the key came out covered with it.

"Such is my experience of cedar wood, and certainly it is the last time I shall use it for any purpose in the Museum.

"The mode in which it acts is singular. Why does it continue to throw out this gum, or rather essential oil, after being so long cut up, and so thoroughly dried to all appearance? Why does it deposit itself on one coin or cast rather than on another? and how did it act on the Canada Balsam? I presume, in the latter case, it acted like turpentine in the form of vapor."

From inquiries made in various quarters, I am inclined to believe that the more resinous firs and pines, as well as junipers (which yield the wood usually termed cedar), cannot be safely employed in the construction of drawers for the reception of objects of natural history. I can, however, testify that the white American fir is perfectly harmless, while it is singularly insensible to the influence of moisture or dryness.

When this subject first attracted my notice, I made inquiry of an upholsterer in Edinburgh respecting the employment of Havannah cedar in cabinet work. He assured me that some years ago it was much used, but that of late it had been abandoned. Another upholsterer gave me a very different view of the matter, by stating that in Edinburgh it was very much used in cabinet work as a substitute for mahogany.

As I feel deeply interested in the safe keeping of objects of Natural History, these remarks have been brought together for the benefit of those who wish to have drawers to preserve, not to spoil, their specimens, and are not intended to excite the slightest alarm in the minds of the possessors of cedar cabinets as wardrobes or book-cases.

P.S.—Since the above was written, I have observed the following

interesting communication to the Linnean Society, 15th March 1842, in the *Annals and Magazine of Natural History*, No. 63, for December 1842. "Mr. R. H. Solly exhibited a cabinet of microscopic objects made of cedar wood, the specimens contained in which, consisting of thirty ground sections of fossil wood cemented on glass, had become covered with a very adhesive varnish. Where the fossil wood was quite sound, and the cement (probably Canada Balsam) did not project beyond its edges, very little of the varnish was deposited; but where the fossil wood was cracked or unsound, or where the cement projected beyond the edge, it was found in considerable quantity; and on the specimens not cemented to glass, it was deposited chiefly in the pores or cracks which had imbibed some of the oil used in polishing the surface. The cabinet was quite new when the specimens were placed in it; and Mr. Solly supposes that the air contained in the drawers had become loaded with vapor from the cedar wood, which, coming into contact with the oil or resin, combined with it to produce a varnish."—*New Edinburgh Philosophical Magazine*.

LETTER TO THE EDITOR.

SIR,—As the labors of yourself and distinguished coadjutors have tended most materially to widen the field of chemical science, I forward a few facts in which the real value of chemistry is peculiarly illustrated in its practical application to the every day business of life. We are all familiar with the gigantic establishments for the illumination of the metropolis, but it is not so generally known that a small apparatus has been constructed by Mr. Hansor which furnishes gas from resinous and oily matters of great chemical purity, with an high illuminating power, and yet so portable that it may be used in any ordinary dwelling house. In Mr. Hansor's apparatus two retorts are employed, the first being used as a simple distillatory apparatus, whilst the second decomposes the condensable vapor. By this arrangement a much lower temperature is required, thus reducing the wear of the retorts and economising the fuel. Mr. Hansor practically ascertains the temperature of his retorts by valves or taps opening into the air, and then regulates the heat by sliding dampers. One of the results of this perfect control is the entire conversion of the gas-making materials into a rich and highly luminous gas, so that little or no carbon is left in the decomposing chamber. Now, this is remarkably in contrast with the results obtained by the patent apparatus for the manufacture of resin gas by Mr. Daniels, or the oil gas by Messrs. Taylor and Martineau. It may be proper to add, that Mr. Hansor's process is so simple in the arrangement of its parts, that in small works now carrying on in Portland Place, Wandsworth, a farm laborer manages all the manipulations for its successful operation.

C. F. P.

BIBLIOGRAPHY.

THE FIRST STEP IN CHEMISTRY. A NEW METHOD FOR TEACHING THE ELEMENTS OF THE SCIENCE. BY ROBERT GALLOWAY, F.C.S., Author of "a Manual of Qualitative Analysis," &c. Second Edition, Re-written, Enlarged, and Greatly Improved, with Illustrations on Wood. London: John Churchill, 1856, 12mo. pp. 303.

THIS little work is constructed on a plan which Mr. Galloway had found very efficient in teaching chemistry not only to adults, but also to boys, even of ten or twelve years of age.

"The plan consists in teaching, by a series of progressive exercises, the nomenclature and notation of the science, the use of the different signs—as the comma and plus—the use of brackets, the construction of formulæ, the mode of expressing chemical changes, the method for determining the several constituents contained in a given quantity of any chemical compound, &c.

* * * * *

"The plan hitherto followed in teaching the rudiments of the science—whether by lecture or books—consists in describing the preparation and properties of various substances—simple and compound—and the combinations they form; and afterwards, the laws of the science. This is analogous to placing a dictionary in the hands of a student desirous of learning a language, and, without *even* instructing him in the alphabet, bidding him learn all that may be stated about each letter, including the various combinations formed by it with other letters, and the properties, &c., of the words thus produced. Even from this imperfect illustration, it will be seen, 1st. That the difficulties of acquiring a knowledge of the rudiments of the science must increase with the facts; whereas, if it were taught in a rational way, the difficulties ought, I think, rather to decrease as the science progresses. 2nd. That it will be perfectly indifferent where the learner commences, as the first lesson will be as difficult as the last; this is really the case:—it is usual to commence with oxygen, but any other element might with as much reason be commenced with, and the first lesson is as difficult as any of the others, even more so than some of the others, if oxygen form the subject of it. By such a plan it daily becomes more impossible to teach the science with any degree of success, especially as a branch of general education; for even under the most favorable circumstances the many remain ignorant, while the few who learn, learn in spite of the system, and not because of it.

"The first lesson in any system ought, I think, to consist in the learner committing to memory the names and symbols of the more commonly occurring elements. And as all experiments are either experiments of combination, or experiments of decomposition, or a combination of the two, the conditions under which combinations and decompositions are effected, ought, I think, rather to be taught in a first course of instruction, than the preparation and properties of the different substances. The following is an imperfect outline of the plan I propose, which is based on these views. The names and symbols of the more commonly occurring elements having been committed to memory, the

learner is taught by a series of experimental exercises, 1st. That two elements can combine together. 2nd. That the compound thus produced may be capable of combining with a further quantity of one of its elements—the combination giving rise to a new compound, just as words like *to*, *be*, &c., are converted into new words by having one of their letters doubled, as *too*, *bee*, &c. 3rd. That two compound substances can combine together, a more complex compound being formed. 4th. That the constituents of any compound are separated, if a substance, having a greater affinity for one of them, be brought in contact with the compound, by reason of the added substance combining with that one, and forming a new compound, whilst the other constituent of the original compound is set free—in such cases combination accompanies decomposition. Afterwards heat, cohesion, elasticity, light, and electricity, as promoters of decomposition, are separately considered and illustrated; and as all the experiments on combination are effected at the ordinary temperature, or by means of heat, the influence of cohesion, elasticity, light, and electricity in producing or opposing combination, is likewise considered.”

This is unquestionably a most excellent School Book and we have no doubt that in those Schools where the Sciences are taught—and to no other should boys be sent in these enlightened times—the teacher will find it a most valuable assistant. We regret that want of space precludes our giving an extract to exemplify the author's plan; but we hope that it will be comprehended by means of the above quotation from the preface.

A MANUAL OF ELECTRICITY; INCLUDING GALVANISM, MAGNETISM, DIAMAGNETISM, ELECTRO-DYNAMICS, MAGNETO-ELECTRICITY AND THE ELECTRIC TELEGRAPH. By HENRY M. NOAD, Ph.D., F. C. S., Lecturer on Chemistry at St. George's Hospital, Author of Chemical Manipulation and Analysis, &c. Fourth Edition, Entirely Re-written, Part I., Electricity and Galvanism. London: G. Knight & Co., 1855, pp. 522.

It is exactly twelve years ago (*See THE CHEMIST* for February, 1844,) that we noticed the first edition of Dr. Noad's now well known and justly appreciated “Lectures on Electricity,” which now makes its appearance in an enlarged form and under a new title, and we are much pleased to observe, that in extending his work the author has given greater development, not only to its bulk, but to its utility and value.

The volume before us treats of Electricity, Frictional and Voltaic, Thermo-electricity, and Electro-physiology. On every part of the subject the author gives the fullest details, and he has had the immense advantage of receiving assistance from Professors Faraday and Tyndall, and from Sir William Snow Harris, as well as from the late Andrew Crosse.

We regret that we have not space for an abstract. However, a sufficient idea of the character of the work may be formed from the title, which, comprehensive as it is, is most ably and fully sustained. We have no hesitation in expressing the very highest opinion of this valuable Manual.

THE CHEMIST.

ORIGINAL COMMUNICATIONS.

On the ELECTRO-CHEMICAL DEPOSITION of METALS.

By ALEXANDER WATT.

(Continued from page 259.)

APPENDIX.

1. In dissolving gold with *aqua regia* (two parts hydrochloric acid and one part nitric acid), care must be taken that the acids employed be pure, and that the gold also be perfectly *fine*, or, at least, not inferior in quality to sovereign gold.

2. If the operator requires to dissolve gold of inferior quality for the purpose of making his gold solution, he should first treat the gold in the following manner:—To one ounce of alloyed gold of the same quality as that which colored gold chains are made of, add two ounces of silver. These are now to be placed in a crucible and melted in a furnace, a little borax being added as a flux. As soon as the alloy is melted, it should be poured into a deep vessel of cold water (kept well stirred in a circular direction all the time), and thus it will become “granulated,” as it is termed. The granulated metal is now to be removed, and placed in a Florence flask, and to be treated with two parts of nitric acid and one part water. The nitric acid will remove all the silver and copper which the alloy contained, and the gold will remain at the bottom of the flask in the form of a dark, brown, irregular mass.

The solution of nitrate of silver and nitrate of copper formed, may now be poured off, and the gold should be frequently rinsed with clean boiling water. The gold may be dissolved in its present state with nitro-hydrochloric acid (*aqua regia*), or it may be put in a crucible with a little potash, and be melted into a button or cast into an ingot.

3. The silver which is contained in the nitrate may be thrown down by placing a piece or several pieces of copper in the solution. In a short time the silver will be found to deposit itself on the copper, and in the course of a few hours the solution will become entirely deprived of its silver. The green liquor (nitrate of copper) may be next poured off, and the silver should be washed several times with hot water. It may then be removed and dried on a sand-bath. The silver may then be mixed with a little perfectly dry potash, and, being put into a crucible, may be melted. It will thus be quite pure, and is most suitable for making silver solutions for electro-metallurgical purposes.

4. The copper contained in the nitrate of copper, formed during the

above operation, may be thrown down in a perfectly pure state by immersing some pieces of iron in the solution, but it is never worth while to reduce the copper resulting from this operation, as it would be both expensive and tedious. The copper solution is generally thrown away, or may be used in the sulphate of copper batteries.

5. When an article is immersed in the silver solution, in connection with the battery, if it assumes a dark color, either the solution is too rich in cyanide, the battery power is too strong, or too great a surface of anode is exposed. Any one of these three conditions will cause the article to be plated to become dark colored when placed in the solution. The operator should immediately remove the article (unless it be made of Britannia metal, pewter, or lead), and have it cleaned again by the usual process. It may then be returned to the solution, a much smaller surface of anode being immersed. If the article receives a proper white deposit this time, the operation may be allowed to proceed, and the anode may be gradually lowered into the solution, little by little, in order that deposition may take place more rapidly.

Should the article, however, still receive the deposit of a dark color, either the solution must be weakened with water, or the battery power must be reduced. But it is better at all times to regulate the speed and color of the deposit by the anode and the battery, rather than to alter the solution, unless the latter has been injudiciously strengthened.

6. When it is desired to give to a plated article, or a portion of the same, that appearance which is technically termed "oxidised," any of the following processes may be employed with success. Sometimes very pretty effects may be produced upon silver surfaces by the "oxidising" processes:—

1. Dissolve 1 dwt. of platinum in two parts hydrochloric acid and one part nitric acid. Evaporate all the acid carefully, and when cold dissolve the mass (chloride of platinum) in a little sulphuric ether or spirit of wine. The chloride may be dissolved in cold water, or it may be used before evaporation. Apply with a camel-hair pencil to the parts to be "oxidised," and as soon as the spirit or ether have evaporated, the pellicle of platinum remaining will give the appearance required.

2. Sulphate of copper	.	.	.	.	2 dwts.
Nitrate of potassa	.	.	.	.	1 dwt.
Muriate of ammonia	.	.	.	.	2 dwts.

Dissolve in a little acetic acid. Apply with a camel-hair pencil. It is better to warm the article before using this mixture.

3. Hydrosulphate of ammonia, strong or diluted, will give either a dark or light "oxidised" surface to silver.

4. The fumes of sulphur will give to silver an extremely beautiful blue, steel-like surface, but the operation should be conducted in an enclosed box, all parts of the article not to be oxidised being protected with a cement.

5. Nitric acid alone will produce an oxidised surface upon silver.

7. Certain parts of an ornamental silver article may have a very

pleasing effect produced upon them by oxidising some parts, gilding others, and by depositing on small portions of the article a coating of copper, which may be done in the following manner:—Dissolve some sulphate of copper, and add a little sulphuric acid, apply this solution to the part to be coated with a piece of steel or with a camel-hair pencil, and touch the part with a piece of steel or zinc, and it will instantly become coated with copper. Any design can be worked in copper by this means, but it is not necessary to state that the amount of copper deposited is very small; consequently, the article should not be subject to much wear.

8. Sometimes, when gilding the inside of mugs, tankards, &c., which are richly chased and embossed, it will be found that the hollow parts do not receive the deposit at all, or very partially. When this is the case, the article should be rinsed and well scratch-brushed, and a little more cyanide may be added to the solution. The anode should be kept in motion, and the battery power increased, until the hollow surfaces are coated. Frequent scratch-brushing aids the uniform deposit of gold to a considerable extent.

9. Silver fillagree brooches and articles which have been annealed in the fire and which cannot be scratch-brushed bright, owing to their peculiarity of form, may also be difficult to gild, for the rough surfaces caused by the fire are very indifferent conductors of the current. It will therefore be advisable to scratch-brush the article as far as is practicable, and to add a little more cyanide of potassium to the solution in which this class of work is to be gilt—the article being constantly moved about, while in solution, until it is uniformly coated.

10. When articles gild a “foxy” color, as it is termed, this is either owing to the presence of excess of cyanide, excess of battery power, or to the exposure of too great a surface of anode. The article being gilt may be improved in color by removing the anode from the solution, and moving the article about in the solution by itself. The battery power, however, should be diminished, otherwise considerable waste will occur in the gold deposited.

11. When a gold solution has been worked for a long time, it becomes impregnated with organic matter, and the deposit which takes place from it is probably of a very indifferent color. In this case, I have found that the solution may be restored by evaporating it to dryness, and then by adding fresh distilled water and a little cyanide of potassium. The heat required to evaporate the solution to dryness does not, as many people suppose, injure the solution or decompose it. It merely appears to destroy the organic matter, and to prevent its influence in the working of the solution. After the solution has been evaporated and fresh water added, it should be filtered.

12. It is sometimes found impossible to make a gold solution work well, when it has been used for several years—even evaporation to dryness will not restore its good working condition. When such is the case, it is better to abandon it, and make another. The gold contained in the old solution may be removed from it by means of the battery, or

by precipitating the gold with acid. If the former plan is adopted, a piece of copper should be attached to the negative wire of the battery, and then (as an anode) be attached to the positive wire. When the battery has been in action for some time, the gold will have become deposited upon the negative pole, and from which it may be readily removed by mechanical means, or may be dissolved off with nitro-hydrochloric acid. If it is desired to throw the gold down with acid, the solution should be placed in a large vessel *in the open air*, as the fumes arising are highly deleterious if breathed, and sulphuric acid should be gradually added until it produces no further action on the solution. The precipitate formed should be allowed to subside, and the clear liquor may be poured off. The precipitate may be washed several times with boiling water; after which it may be dried, and may then be mixed with a little dry potash, and be placed in a crucible, and heated in a furnace until all the gold is gathered into a button at the bottom of the crucible. The operator will seldom find that he can get nearly the amount of gold from his old solution that was originally put into it. Owing to the irregularities of working, the solution becomes deprived of a considerable portion of its gold, and I have frequently found old solutions to yield scarcely any gold, when reducing them by the process named, although I have been exceedingly careful in the manipulation.

13. When a silver solution is found to work badly and it appears almost impossible to restore it by the ordinary means, the operator may precipitate the silver with sulphuric acid in the manner described above, and, having well washed the precipitate, he may re-dissolve the same with a concentrated solution of cyanide of potassium. Water may now be added until the solution is found to work well. It is as well, however, after dissolving the precipitate, to filter the solution, at least once, before adding the water.

14. If, then, anodes of silver are used, or, if the solution contains so much free cyanide that the anodes dissolve away irregularly, so that numerous small particles of silver drop off the anode, these particles will, by falling upon the work to be plated, cause the articles to be rough. It is therefore advisable, under such circumstances, to place the anode in a canvas bag, or a bag made of brown Holland linen, by which means, the small particles of silver will be collected and prevented from falling upon the work. These small portions of silver may be collected, from time to time, and, being melted, may be cast into an ingot, and rolled out to form an anode for another occasion.

15. In plating Britannia metal, it is advisable that the deposit be allowed to take place rather quickly at first, in order that the article may be thoroughly coated *at once*, for if the deposit takes place slowly, some portions of the article will receive the deposit before others, and the article will probably "strip."

16. When it is desired to remove the silver from articles which have been plated, either for the purpose of re-plating them, or because the deposit is of an objectionable character, the operator proceeds as follows:—

Place in a stone-ware vessel some concentrated sulphuric acid, to which add a few crystals of nitrate of potassa (saltpetre). Submit this to the heat of a sand-bath, carefully, and, when hot, it is ready for use. The articles to be "stripped" are then placed in this acid attached to a copper wire, and they are occasionally moved about, in order that the operation may take place uniformly. If the process is slow, more nitrate of potassa may be added from time to time. As soon as the articles are "stripped," they should be well rinsed, and may then be cleaned for plating in the ordinary way. Sometimes old articles which have been made out of plated metal will, when the silver is thus removed from them, be rough. This is in consequence of the surface of copper not having been rendered smooth, before plating. The articles may, however, be polished by the ordinary means, at a lathe, or be rendered smooth with emery cloth, and powdered pumice-stone and oil.

In stripping articles in the above solution, the operator should take care that the fumes arising from the process are not allowed to enter the apartment in which he is operating, as they are exceedingly offensive and injurious. The process should be carried on upon a sand-bath, with an open flue above, to carry off the fumes; or upon the hob of a common fire. When the stripping solution has become charged with silver, this metal may be thrown down by diluting it with water, and then placing some pieces of zinc, which will reduce the silver in the form of minute crystals, which may be washed, dried, and melted; or when a new silver solution is required, these crystals may be dissolved in nitric acid, and the solution proceeded with as described in a former article.

17. Generally speaking, the silver thrown down from the above solution, if melted and cast into an ingot, will, if it be submitted to the "flattening mills" for the purpose of rolling it out, crack under the operation; in which case, it will be necessary to re-melt it with a little copper, which will render the silver sufficiently "tough" to roll without cracking.

18. Gold may also be stripped from articles which are to be re-gilt, or from which it may be desirable to remove the gold for other reasons, by placing the articles in strong nitric acid, to which a little dry common salt has been added. When the gold has been removed, the articles are to be immediately rinsed, and prepared for gilding in the ordinary way.

19. When the above solution of acid and salt has accumulated a large amount of gold, when it begins to work tardily, the gold may be collected, by evaporating the solution to dryness, and fusing the residuum, with a little soda or potassa. As the gold may probably crack when submitted to the rollers, it will be as well to add a little copper when melting it.

(To be continued).

CHEMICAL TABLES, COMPILED BY THORNTON J. HEERAPATH.

SUPPLEMENTARY TABLES TO TABLE IV.

TABLE FOR TESTING BY THE BLOWPIPE.

With Microcosmic Salt, in the Oxidising flame (O.F.)		With Borax, in the Oxidising flame.		Substances.	REMARKS.
Reducing flame (R.F.)		Reducing flame.			
Bead, <i>blue</i> (very deep); hot and cold.	Bead, <i>deep blue</i> .			1. Oxide of co- balt.	<i>Compounds containing chromium, when fused with nitre and potash in a silver crucible, yield a yellow mass, containing chromic acid.</i>
Bead, <i>green</i> ; <i>reddish</i> while hot.	Bead, <i>bright green</i> .	Bead, <i>green</i> .		2. Chromium, ox- ides of.	
Ditto; <i>bluish green</i> when cold.	Bead, <i>brownish red</i> .			3. Copper, oxides of.	<i>Compounds containing copper, when fused with soda on charcoal, yield metallic copper. Copper is malleable, and red in color; is acted upon by nitric acid, giving a solution which is turned blue by an excess of ammonia.</i>
Ditto; <i>yellow</i> while hot.	Bead, <i>bright green</i> .	Bead, <i>yellow</i> .		4. Uranium, ox- ides of.	<i>Compounds containing manganese, when fused with nitre and potash (see 2), yield a bright green mass (mineral chameleon),</i>
Bead, <i>amethystine</i> when hot; <i>pale</i> when cold; the color is rendered darker by nitre or borax.				5. Manganese, ox- ides of.	
Bead, <i>yellow</i> .	Bead, <i>green</i> ; <i>brown- ish</i> while hot.	Bead, <i>yellow</i> .	Bead, <i>green</i> .	6. Vanadium, ox- ides of (vana- dic acid).	<i>On charcoal are only partially re- duced; with soda, on ditto, fuses and are absorbed.</i>

Bead, <i>yellow</i> ; when the oxide is excess, <i>opalescent</i> .	Bead, <i>grey</i> , from reduced silver.	Bead, <i>colorless</i> .	Bead, <i>grey</i> .	7. Silver, oxides of.	Compounds containing silver, on charcoal in R.F., alone or with soda, are easily reduced. <i>Silver is easily fused, silvery white in color, malleable, and not oxidizable, B.B.; is soluble in nitric acid, and the sol. yields a white curdy precipitate with hydrochloric acid.</i>
Bead, <i>yellow</i> ; almost <i>colorless</i> when cold; a great excess of oxide produces an enamel.	Bead, <i>grey</i> , from reduced bismuth.	Ditto.	Bead, <i>grey</i> .	8. Bismuth, oxides of.	Compounds containing bismuth are easily reduced on charcoal in R.F. <i>Bismuth is pinkish-white in color, and rather brittle; is easily oxidized, giving a brownish-yellow oxide, and very broad areola. It is sol. in nitric acid, and yields a solution which furnishes a white precipitate on the addition of water.</i>
Bead, <i>red</i> or <i>yel.-red</i> while hot; <i>pale</i> , when cold.	Bead, <i>colorless</i> when cold, but <i>red</i> when hot. If tin is added, it becomes first grey and opaque, and then <i>colorless</i> . Bead, <i>colorless</i> .	Bead, <i>pale</i> when cold; fused with a little nitre, the color is changed to <i>blue</i> . Bead becomes <i>opaque</i> when heated in the intermitting flame. Bead, <i>bottle green</i> .		9. Nickel, oxides of.	Easily reduced on charcoal; color of metal, white; metal, dif. fusible, and attracted by the magnet. <i>It is sol. in nitric acid, and the solution becomes light blue on the addition of ammonia in excess.</i>
Ditto.				10. Cerium, oxides of.	Are not reduced on charcoal.
Ditto.	Bead, <i>green</i> .			11. Iron, oxides of.	B.B. in the O.F., compounds containing iron give a black magnetic scoria; <i>this, when finely powdered, is red in color.</i> On charcoal, in R.F., they yield a grey mass of metallic iron, which is highly magnetic.

With Microscopic Salt in the Oxidising flame (O.F.)	With Microscopic Salt in the Reducing flame (R.F.)	With Borax, in the Oxidising flame.	With Borax, in the Reducing flame.	Substances.	REMARKS.
Beads nearly <i>colorless</i>, or rendered dark-colored and opaque by particles of reduced metal. [At a high temperature, 12 separates as a metallic globule, and the bead becomes colorless.	As in the oxidising flame.	As with Micro-cosmic salt.		12. Gold, oxides of. 13. Platinum, oxides of. 14. Palladium, oxides of. 15. Rhodium, oxides of. 16. Iridium, oxides of.	Are easily reduced, B.B. Metal less fusible than silver; <i>soft and malleable; yellow in color</i>, and not oxidisable, B.B. It is not acted upon by nitric or hydrochloric acid, <i>but is sol. in aqua regia, even in the cold, giving a yellow sol. A drop or two of the latter, when smeared on a porcelain plate, and heated to redness, gives a fine purple metallic stain.</i> When the spongy reduced metal is strongly pressed in a pestle and mortar, it becomes bright and splendid. Platinum is insol. in cold nitromuriatic acid. Ditto. Ditto. Ditto.
Bead, <i>colorless</i>. When added in excess, these bases give beads which are <i>milky white</i> when cold; with oxide of lead, the bead is <i>yellowish</i> while hot.	As in the Oxidising flame.	As with Micro-cosmic salt.		17. Lead, oxides of.	Compounds containing lead are easily reduced by soda on charcoal, in R.F. Lead is <i>bluish-white, very soft and malleable, easily fusible, and yields a broad areola and yellow oxide on charcoal in O.F.</i>

When added in excess, these bases give beads which are <i>milky white</i> when cold; with oxide of lead, the bead is <i>yellowish white</i> hot.		
Bead, <i>colorless</i> .		
Ditto.	As in the Oxidising flame.	As with Micro-cosmic salt.
Ditto.		
Ditto.		
Ditto.		
Ditto.		
Ditto.		

Compounds containing zinc are reduced with some difficulty, B.B. Zinc itself is bluish-white in color, and rather brittle: is easily oxidized, giving off, B.B. (in O.F.), white fumes of oxide of zinc, and yields a broad areola on charcoal. The oxide is yellow when hot, but white when cold; it turns green when moistened with a weak sol. of nitrate of cobalt, and again heated, B.B. Compounds containing cadmium, when heated on charc., B.B., give a broad areola of brown oxide of cadmium.

All these earths emit a glaring white light when heated on charcoal, B.B.

Chloride of barium in alcohol gives a *green flame*. Anhydrous baryta is infus.; the hydrate and carb. fuse, B.B. Chloride of strontium in alcohol gives a *red or scarlet flame*. Hyd. of strontia is fus., the carb. only partially fus. Chloride of calcium in alcohol gives a *dull red flame*. Lime and its hyd. are infus.; so also the carb.; but the latter is easily converted into caustic lime. When moistened with a sol. of nitrate of cobalt, it becomes *flesh red*, B.B. Is infus., B.B. Compounds containing glucina, give a dark-grey slag with nitrate of cobalt. (See 13.)

18. Zinc, oxide of.

19. Cadmium, oxide of.

20. Baryta.

21. Strontia.

22. Lime.

23. Magnesia.

24. Glucina.

On the DETERMINATION of BISMUTH by WEIGHT and by VOLUME.

By MR. R. WEST PEARSON, of Manchester.

THE method usually employed for the determination of bismuth, consists in heating the solution of the metal with sulphuretted hydrogen, and filtering off the precipitated sulphide of bismuth, which, after washing, is decomposed by digestion with nitric acid. In this way, nitrate of bismuth is formed and free sulphur, which is removed by filtration. After which, the bismuth is precipitated from its solution as carbonate of the oxide. Upon the first addition of the alkaline carbonate, a considerable quantity of the precipitate produced is re-dissolved, and several hours exposure is necessary to re-precipitate it. A. Stromeyer * states that the precipitate produced is by carbonate of alkali, is somewhat soluble in excess, but re-precipitated by caustic alkali. According to L. Laugier,† the precipitate is completely soluble in carbonate of ammonia, partly so in carbonate of potassa, and insoluble in carbonate of potash; according to Berzelius,‡ however, oxide of bismuth is not soluble in carbonate of ammonia, unless phosphoric acid or arsenic acid is present. Rose§ directs that to obtain that portion of bismuth which remains in solution, after continued exposure, it is necessary to repeat the operation just indicated, *i. e.*, precipitate as sulphide, obtain in solution as nitrate, precipitate as carbonate, and convert into oxide of bismuth by ignition. This method, it is evident, is open to a great objection in the amount of time consumed in its execution. It is inapplicable to solutions containing hydrochloric acid or metallic chlorides, also to such as contain lead or cadmium. If either of the latter exist in solution, their removal must be effected by separate processes. For the volumetric determination of bismuth, no method has hitherto been proposed.—To supply the desideratum which ~~there~~ exists in chemical analysis, I began a series of experiments, and in the present communication, I have to describe a method which I find to yield satisfactory results.

It is based upon the fact that chromic acid, when in liquid contact with bismuth, combines in constant proportions to form an insoluble compound of definite composition, and produced under all circumstances. The value of this reaction as the basis for a volumetric mode of analysis, depends upon the characteristic color of chromic acid and its compounds.

I will proceed to describe the results of some experiments on the nature of the reactions upon which the method is based; secondly, to notice the estimation of bismuth by weight; thirdly, its determination by volume; and lastly, deduce the combining ratio of bismuth and chromium.

Chromate of potash (KO, CrO_3) precipitates, on addition to solutions of most metals, chromates corresponding to the formula (MO, CrO_3). Bichromate of potash ($\text{KO}, 2\text{CrO}_3$) combines by double affinity, as in

* Pogg. Ann., 26-553.

† Ann. Chim. Phys., 36-332.

‡ Jahresber, 12-166.

§ Handbuck.

the case of simple chromate of potash, the former giving rise to bichromate compounds, of the formula MO , 2CrO^3 , which are, without exception, soluble in water.

A peculiar combination of bichromate of potash takes place on its addition to salts of bismuth, viz., the formation of a simple chromate of bismuth (BiO^3 , CrO^3), in which each equivalent of oxide of bismuth is united to one equivalent of chromic acid. Upon inquiry into the reaction of bichromate of potash with other bodies, I found that the phenomena of the two equivalents of chromic acid contained in that of bichromate of potash combining separately with single equivalents of other bodies, took place among the metals with lead and bismuth, and among the alkaline earths with baryta only. I invariably found that acid solutions of other bodies remained perfectly clear on the addition of bichromate of potash. By means of this agent, therefore, lead, bismuth, and baryta, may be separated, singly or together, from all other bodies when in solution. I also found, that while chromate of baryta is readily soluble in dilute nitric acid, chromates of lead and bismuth are comparatively insoluble.

Chromate of lead is readily and completely dissolved by caustic potash or soda, and differs in this respect from bismuth chromate.

The solubility of chromate of bismuth in water, acetic acid, nitric acid, and caustic potash, I determined quantitatively. I immersed a quantity of well-washed chromate of bismuth in those liquors for twelve hours, with frequent agitation of the mixture. To determine the quantity of bismuth dissolved from the tints produced in the supernatant liquor by sulphuretted hydrogen, I prepared dilute solutions of bismuth, containing a known quantity of the metal, and passed sulphuretted hydrogen gas through each solution, and in this way I got "comparison tests" of bismuth. When examined by this method, I found the following to be the

Percentage Solubility of Bismuth in Water, Acetic Acid, Nitric Acid, and Potash.

	In Water.	In Acetic Acid.	In Nitric Acid, sp. g.	In Potash, sp. g.
Chromate of Bismuth.	·00009	·00021	·00025	·00016

I found, by experiment, that the following reactions take place with bichromate of potash and nitrate of bismuth :—

70,000th grain of bismuth precipitate immediate.
 100,000th „ „ opalescence produced.
 150,000th „ „ reaction ceases.

The characteristic color of chromic acid is possessed in a remarkable degree by the chromates of potash. Thompson states that one part of simple chromate of potash may be recognised in 40,000 parts of water. I found that the bichromate of potash when diluted 70,000 times could be clearly perceived, that is, one grain of the bichromate salt, diffused

in a gallon of water, may be detected by the yellow color it imparts to the fluid.

ESTIMATION OF BISMUTH BY WEIGHT.

Previous to precipitating the bismuth in solution as chromate of bismuth, it is necessary, as when precipitating by carbonate of ammonia, to ascertain the absence of lead. This may be effected, and, if present, its removal accomplished by processes to be described further on. The proper solvent for bismuth compounds, is nitric acid, expelling any excess by evaporation. In the absence of lead, the solution is supersaturated with bichromate of potash, and the mixture warmed to aggregate the precipitate, which is collected upon a filter and well washed with water. The precipitate and filter are dried, transferred to a crucible, and calcined. The metal, or its oxide, is calculated from the chromate of bismuth obtained.

Separation of Bismuth from Lead and Baryta.—I include baryta, since, on the removal of lead and baryta, bismuth may be estimated directly without further manipulation. In systematic analysis we should have to deal with lead only. I have found three methods available for the separation of lead and baryta from bismuth.

1st method:—Add to the solution containing, amongst other substances, lead, bismuth, and baryta, dilute sulphuric acid in excess.

Sulphate of lead and baryta will precipitate. Filter from the insoluble sulphates produced. The filtrate which contains the whole of the bismuth, as soluble sulphate, is freed from excess of acid, bichromate of potash added, and the experiment proceeded with as indicated above.

2nd method:—If necessary, add a slight excess of nitric acid to the solution, and precipitate with bichromate of potash; on filtering, baryta will remain in solution, soluble in nitric acid, and may be precipitated as sulphate of baryta for estimation. The precipitated chromates of lead and bismuth are now treated with caustic potash or soda, when the whole of the lead will be dissolved, and, by filtration, may be completely separated from the insoluble bismuth chromate. If the amount of lead is required, it is simply necessary to acidify the alkaline solution, and add a few drops of bichromate of potash, and determine as chromate of lead. The bismuth is calculated from the chromate of the oxide, which remains as in 1.

3rd method:—It is known to chemists, that oxalic acid and oxalates precipitate salts of bismuth as oxalate of the oxide. But I believe it has not been noticed that the precipitate so produced, is soluble in an excess of oxalic acid. Such I find to be the case. Since oxalic acid combines with lead and with baryta also to form oxalates insoluble in excess of the acid, it is evident, that the property of bismuth I have just mentioned will enable us to separate the latter from the two former with great facility.

The extreme delicacy of the precipitation of both lead and baryta by oxalic acid, adds to the value of this reaction.

To this last and new method of separation, I, therefore, give the preference, especially where great accuracy is desired.

To the solution containing lead, bismuth, &c., from which excess nitric acid has been removed by evaporation, oxalic acid is added in slight excess, or a neutral oxalate, and then an excess of oxalic acid, and the mixture gently heated and filtered. The precipitate which contains the lead and baryta is washed to remove bismuth, and the filtrate super-saturated with a solution of lime, warmed and filtered. The solution which is entirely free from baryta, lead, or excess of oxalic acid, is now precipitated with bichromate of potash. If the bismuth is to be determined by weight, the removal of oxalic acid is not necessary, but if it is to be estimated by volume, absolutely so.

Separation of Bismuth and Cadmium.—No accurate method is known for the separation of these two metallic oxides. By means of bichromate of potash, I find that their separation can be effected with great facility, since bichromate of potash does not precipitate salts of cadmium. In a solution containing 2.186 grs. of cadmium and 2.123 grs. of bismuth, I obtained, taking the cadmium by difference:—

Cadmium	:	:	:	:	:	2.1861
Bismuth	:	:	:	:	:	2.1229

ESTIMATION OF BISMUTH BY VOLUME.

I have stated that the chief value of the reaction upon which the method just described for estimating bismuth by weight is based, as a volumetric mode of analysis, upon the color of chromic acid and its compounds. In the case of a colorless liquid, a graduated solution of bichromate of potash is added, until further addition ceases to precipitate bismuth from its solution as insoluble chromate. By observing the effect of continued addition, it is easy to notice the rise of a yellow color in the supernatant liquor. This indicates an excess of bichromate, and, of course, the saturation of the fluid. This method, it is evident, is of use for colorless liquids only. For technical purposes, as in the examination of ores and the analysis of alloys, a simple modification enables us to extend the range of the volumetric method to colored solutions. Upon a white porcelain slab, a number of dots of a saturated solution of acetate of lead, or nitrate of bismuth, are set. To the colored solution of bismuth, &c., bichromate of potash is added; after each addition of the bichromate salt, a glass rod, drawn to a fine point, is inserted and brought in contact with a dot of the salt of lead on the white slab. So long as any bismuth remains in solution, no change will take place; but so soon as bichromate of potash is in excess, and therefore, when bismuth is entirely removed, the wet rod, on coming in contact with the lead salt, will give rise to a yellow milkiness due to the formation of chromate of lead. In this way, pretty correct results can be obtained.

Preparation of Standard Solutions.—Bichromate of potash, the agent to be employed, as met with in commerce, is usually contaminated with sulphate of potash in quantity, the removal of which is necessary to ensure accuracy. This may be effected by repeated crystallisation of the salt.

7135 grs. of pure crystallised bichromate of potash are dissolved in 100 grs. of water, in a large, graduated test-mixer, or other convenient

vessel, the stopper inserted and thoroughly agitated. The solution must be perfectly clear, and should be kept in stoppered bottles. To avoid subsequent repetition, I shall call this solution the "bichrome test," and to distinguish from subsequent ones, affix the letter A—bichrome test A.

In a similar way, I prepare a second solution, one-tenth the strength of bichrome test A; .07135 grs. of bichromate of potash diffused in 100 grs. of water will furnish such a solution. I call it the bichrome test B. Bichrome test C, one-tenth the strength of solution B, is also prepared by dissolving .007135 grs. of the bichromate of potash in 100 grs. of water.

These figures can be multiplied to any convenient number. A large quantity can be prepared in the same time as a small quantity.

These solutions will contain bichromate of potash in 100 grs. of bichrome test A, equal to 1 gr. of bismuth in 100 grs. of bichrome test B, equal to 0.1 gr. of bismuth, and in 100 grs. of bichrome test C, equal to .01 gr. of bismuth. Great care is required in the preparation of these solutions, since it is evident, that upon their correctness depends the value of any results that may be obtained by their use. Having got perfectly correct standard solutions, their use remains to be noticed. In my own experiments, I make use of a white glass flask capable of holding about 2000 grs. of liquid. As it is advisable to keep the solution hot during the experiment, I use a test-tube holder fixed upon a moveable stand, or, what is equally convenient, a clasp of iron plate with a wooden handle. Both these solutions can be slipped round the neck of the flask (which must have a rim) at pleasure. An alkalimeter, such as is in common use for centigrade testing, consists of a graduated tube, of such a capacity that when full it contains 1000 grs., subdivided into 100 measures of 10 grs. each. For ordinary determinations, such an instrument is sufficiently accurate, but where extreme delicacy is required, I make use of more finely graduated instruments; such alterations will suggest themselves to the operator. It may be as well to notice the change which takes place on the addition of bichromate of potash to nitrate of bismuth. It may be expressed thus:—



The chromate of bismuth is of a rich yellow color. In warm solutions it is deposited almost instantly. On the addition of one or two drops of the bichromate only, the precipitate diffuses itself throughout the mixture, imparting a yellow milkiness to the whole fluid; further addition of bichrome test causes the aggregation of the precipitate, and on the experiment approaching completion, it coagulates speedily, leaving the supernatant liquid perfectly free from any floating particles. On complete saturation of the liquid, chromate of bismuth will cease to precipitate, and simultaneously the characteristic color produced by excess of the bichromate will appear.

QUANTITATIVE RATIO OF BICHROMATE OF POTASH AND METALLIC BISMUTH.

In adopting centigrade methods of analysis, it becomes a matter of

vital importance to determine with the greatest accuracy the atomic weights of the body to be estimated, and also of the agent by which its determination is to be effected. The metal to be estimated by the method now described, is bismuth. If we adopt, with Gmelin, the formula BiO^3 for the oxide of bismuth, we find that the following atomic weights have been assigned to the metal.

According to Berzelius, it is 213; according to Kane, 218. Gmelin* deduces from his experiments 210, or even less. Lagerhjelm assigns the atomic weight 212·86, and this is adopted by Dr. Miller† in his recent work. To the metal chromium, which, of course, materially affects that of bichromate of potash, the following atomic weights have been assigned:—26—26·27—27—28.

The following table gives the quantities of bichromate of potash that would be required to combine with 100 parts of bismuth, according to the various atomic weights that have been assigned to the metals chromium and bismuth; potassium is taken at 39.

Atomic weights of Bismuth.	Chromium at 26.	Chromium at 26·27.	Chromium at 27.	Chromium at 28.
210	70·00	70·20	70·90	71·90
212·86	69·06	69·74	70·00	71·41
213	69·01	69·40	69·74	70·89
213·3	68·90	69·17	69·20	70·79

Upon examining the above table it will be found that the maximum quantity required is 71·90, and the minimum quantity 68·90; a difference too great to be attributed to experimental error. No correct data being furnished by this comparison, I proceeded to ascertain by experiment the exact quantity of bichromate of potash required to combine with a known weight of bismuth.

This data I obtained by dissolving known quantities of pure bismuth in nitric acid; from this solution I precipitated the bismuth by bichromate of potash, in two or three ways: first, without regard to the quantity of bichromate used, simply weighing the precipitate got; secondly, in the volumetric way, by means of standard solutions. I also estimated the bismuth by adding a known excess of the precipitant, and calculated from the amount of excess so added. I ascertained, by a standard solution of bismuth, the mean of all my experiments gave 71·35 as the quantity required to combine with 100 parts of bismuth.

TOBACCO ADULTERATIONS.

By F. CRACE-CALVERT, F.C.S., M.R.A., of Turin, &c.

I WAS requested, some time since, to examine four samples of tobacco, two of which appeared to be genuine, and two of inferior quality, and, no doubt, largely adulterated. I first submitted these four samples of

* Gmelin's Handbook, by Watt, Vol. IV.

† Miller's Elements Chem., Part Second. (1856).

tobacco to various tests, with the view of discovering any treacle or chloride of sodium which they might contain, but did not detect the presence of these substances.

I therefore carefully examined the four samples of tobacco, and remarked in one of the inferior ones, a piece of iron, the appearance of which led me to think that, perhaps, the tobacco had been adulterated with a certain quantity of iron-filings. To ascertain if this curious and novel mode of adding weight to tobacco had been resorted to, a magnet was passed through the tobacco, and, as it became rapidly covered with iron filings, no doubt could remain in my mind that iron had been employed. The mixture of iron with tobacco was a very good one, for it was only by a careful examination that it was remarked by me, and, consequently, a casual observer would not have noticed it. I further found, by a few trials made on a given weight of the tobacco, that the amount of iron was from 2 to 3 per cent.

Having also remarked in two of these tobaccos, small lumps of an unusual appearance, I separated a certain quantity of them, and treated them with weak hydrochloric acid, when a partial solution of them was effected; the liquors obtained were neutralised, and then concentrated to the state of a syrup, which was introduced into a retort, with an excess of caustic potash, and the whole submitted to distillation, when only a mere trace of nicotine was obtained. Consequently the lumps were composed of some other substance than tobacco. A further proof of this was obtained by calcining a certain quantity, when the odor given off was not the characteristic one of tobacco; but, in one of the samples, resembled that of coffee, whilst the other gave that of chicory; and although I could not obtain positive proof that the substance used was chicory, still the following result will show that the lumps were not made of tobacco. An aqueous solution of genuine tobacco was tested comparatively with one made with pure chicory, and also with one made with the suspected lumps, and these are the results obtained:—

	Tobacco.	Chicory.	Lumps.
Nutgalls	a precipitate	none	none
Bichloride of mercury.....	ditto	none	none
Bichloride of platinum ...	ditto	none	none
Nitrate of silver	ditto	none	none

It will be observed that the solution prepared with the lumps did not give any of the reactions of tobacco or nicotine, but those of a solution of chicory or of a similar substance.

Having noticed that the lumps, when calcined, left a large amount of ashes, I took some tobacco from two of the four samples, and having dried them at 215° until they lost no more water, I found, that besides losing from 25 to 30 per cent. of water, they yielded the undermentioned amount of ashes.

To render the analysis more complete, I first separated these lumps

with a pair of nippers, and then passed the remainder of the tobacco through a sieve, and these separated portions of the tobacco gave, on calculation, the following results :—

	No. 2.			No. 3.			No. 1.	No. 4.
	Tobacco 100 gra. dried at 215 degs.	Siftings 100 gra. dried at 215 degs.	Lumps 100 gra. dried at 215 degs.	Tobacco 100 gra. dried at 215 degs.	Siftings 100 gra. dried at 215 degs.	Lumps 100 gra. dried at 215 degs.	100 gra. dried at 215 degs.	100 gra. dried at 215 degs.
Organic matter	74·60	63·00	68·90	78·60	60·80	65·40	80·90	82·79
Ashes	25·40	37·00	31·10	21·40	39·20	34·60	19·10	17·21
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

The above-named ashes were composed of—

Soluble in water	4·30	1·14	2·50	5·40	1·30	3·00	2·70	4·11
Soluble in acid	5·21	7·37	8·03	8·64	6·87	7·55	8·39	8·55
Residue insoluble in acid, or sand mixed with a little gyp- sum	15·00	26·09	20·00	7·00	28·70	23·40	12·80	9·30
Oxide of iron	0·89	2·40	0·57	0·36	2·43	0·65	0·21	0·25
	25·40	37·00	31·10	21·40	39·20	34·60	19·10	17·21

On perusing this table we must be struck by the enormous amount of residue insoluble in water and acid, which exists in the siftings of No. 3, to the amount of 28·70, and in No. 2 of 26·06 grs., and which is composed chiefly of sand, with small quantities of gypsum. These numbers are widely different from those of Nos. 1 and 4 tobacco, which contained only 12·80 and 9·30 grs.

With the view of ascertaining the real amount of adulteration in the tobaccos placed in my hands, I analysed, comparatively, the following samples of tobacco, which were bought in a respectable shop in this town, and these are the results obtained :—

	Rough Cut (Public-housesup- ply).	Returns.	Bristol Bird's-eye.
Organic matter	79·37	81·32	82·07
Ashes	20·63	18·68	17·93
	100·00	100·00	100·00
Mineral matter com- posed of—			
Soluble in water	6·31	4·41	7·55
Soluble in acid	11·01	11·27	8·76
Insoluble in acid	8·31	3·00	1·62
	20·63	18·68	17·93

Therefore, it is clearly seen that the lumps, as well as the siftings
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obtained from the suspected tobacco contained about from 14 to 19 per cent. more mineral substances (chiefly sand) than is contained in the two other samples sent to me at the same time, and marked Nos. 1 and 4, and also from 16 to 21 per cent. more ashes than the tobaccos of good quality, bought by myself. Therefore, if we add to the enormous proportion of mineral adulterations, the other adulterations, such as coffee, and probably chicory, together with the large amount of water which retailer's tobacco generally contains, we may fairly conclude, that if the two adulterated samples of tobacco which I examined had been allowed to go into the retail shop, the buyer would not have had above 50 per cent. of real tobacco, the rest being rubbish, and of no value to him.

I have been induced to publish the above facts, with the view of drawing the attention of chemists to the novel mode of adulterating tobacco with such a weighty substance as iron, and to give a few data as to the amount of ashes left by tobacco on calcination.

On the COMPARATIVE VALUE of PEAT and PEAT-CHARCOAL for AGRICULTURAL PURPOSES.

By EDMUND W. DAVY, A.B., M.B., M.R.I.A., &c., Dublin.

Abstract of a Paper read December 28th, 1855, at one of the Scientific Evening Meetings of the Royal Dublin Society.

THE property which peat and peat-charcoal possess of removing the odor from excrementitious substances, and other offensive matter is now well established, and both may be usefully employed as deodorisers for sanitary purposes; and it becomes little more than a question of expense which should be used for this object.

A difference of opinion, however, is entertained, whether peat or peat-charcoal is the best adapted to deodorise animal excreta, &c., where the object is to manufacture manures.

The advocates for the use of peat-charcoal allege, as one of the most important of its properties, that when mixed with decomposing animal excreta it absorbs and retains the ammonia which is evolved from such matter. If peat-charcoal really does this, it effects a valuable object, as the importance of ammonia as a food of plants, and a fertiliser of the soil, is now well established.

With a view to throw some light on this subject, if possible, I made some comparative experiments with peat and peat-charcoal on stale urine, which by decomposition had become highly ammoniacal.

The peat and peat-charcoal employed were from the same sods, and the peat-charcoal was freshly made, and both when used were in the state of coarse powder, the particles of each being about the same size.

Having ascertained by experiment the amount of ammonia existing in a given quantity of the urine, I mixed intimately an equal quantity of it, with the same weight of peat and of peat-charcoal; and placing

the mixtures in open vessels of the same size, left them exposed to the air.

On examining the mixtures, after only four days' exposure, it was found that where the peat-charcoal had been employed, more than three-fourths of the entire quantity of ammonia existing in the urine added, had been evolved and lost, whereas, in the case of the peat, the ammonia of the urine was completely retained in the mixture.

These experiments show that peat-charcoal (contrary to the statements which have been made by its advocates), has very little power of absorbing and retaining the ammonia of decomposing excrementitious matter, when mixed with it; whereas peat possesses this valuable property in an eminent degree, and absorbs and retains it in a most striking manner.

The evolution of ammonia in the case of peat-charcoal seems to arise from two causes, namely, its inability to retain the volatile carbonate of ammonia existing in decomposing animal matter; and the property I have observed it to possess, of decomposing, to a certain extent, the fixed salts of ammonia, as, for example, the sulphate, phosphate, muriate, and urate, which may be present in such matter, and converting them also into the volatile carbonate, which is readily evolved. This latter property, which would seem to depend on the earthy and alkaline carbonates formed in the charcoal during the process of charring, is not possessed by the peat. These facts prove the great superiority of peat over peat-charcoal for agricultural purposes, as regards the important substance ammonia; for, by the use of peat, the ammonia is retained more or less completely in the manure, to exercise its fertilising action on vegetation, whereas, the peat-charcoal suffers it to be in great part dissipated and lost.

As regards carbonic acid, the great food of plants, peat has also a decided advantage over peat-charcoal, as the former readily undergoes decomposition in the soil, particularly if it is in contact with decomposing matter, such as excrementitious substances, and gives rise to carbonic acid in the soil, both to supply the wants of the young plant before its leaves are sufficiently formed to obtain this indispensable substance from the surrounding atmosphere, and to render soluble in water certain earthy salts, &c., required by vegetation, and present them in a state in which they can easily be taken up by the roots of plants. Charcoal, on the other hand, from its being so little liable to undergo change, or be oxidised and converted into carbonic acid at the ordinary temperature, would, under the same circumstances, furnish only a very minute quantity of carbonic acid, even after the lapse of a long period.

Peat, likewise, from its greater electricity, is better calculated than peat-charcoal, to improve the texture, and render more pervious to the air heavy clay soil deficient in vegetable matter; and, besides many other arguments which might be adduced in its favor, peat, in the partially* dried and coarsely powdered state in which it should be

* The peat used in these experiments contained about 28 per cent. of water.

employed, would only be about one-fifth, if so much, of the expense of peat-charcoal.

All these circumstances show how greatly superior peat is to peat-charcoal for agricultural purposes.

TRANSLATIONS AND ABSTRACTS.

MINERALOGY.

PRESENCE of VIVIANITE in HUMAN BONES.

By M. J. NICKLES.

IN the midst of human bones accumulated for several centuries in the charnel-house of the Cemetery of Eumont (Meurthe), there have been remarked, not without interest, two bones of a woman, a cubitus and a radius, distinguished by a blue-green coloration. One of these bones, the cubitus, having been broken by some curious person, the coloration was found to be general, and the osseous substance was affected by it throughout its thickness.

This bone having been sent to me, I made the observations and experiments of which the following are the results:—The coloration verged powerfully on green; but, considering that osseous matter was yellow, it was evident that the coloring matter should be blue. However, it was not due to a cupreous compound; for, by dissolving a piece of bone in hydrochloric acid, and supersaturating with ammonia, a white precipitate of phosphate of lime, tinged with blue, was obtained. The supernatant liquid was colorless; therefore, there was no copper present. The reagents indicated iron; but as all bones contain iron, it was not at first very easy to ascertain whether this metal formed an integral part of the coloring principal, or although this principle might very well be only phosphate of iron.

In pursuing my investigation, I soon ascertained that it was so: after dividing the pieces of bone which I had to experiment on, and explored the medullary canal with the aid of a lens, I recognised, in the midst of the sinuosities left by the hardened marrow, brilliant points, presenting the characters of a true crystallisation. These brilliant points having been examined by means of a microscope, it was readily perceived that they constituted rhomboidal prisms appearing oblique, some of which were surmounted by a horizontal prism, whilst the others, furnished with octohedral facettes had terminal faces applied to two extremities of the macrodiagonal. The smallness of these crystals did not admit of their being measured goniometrically, but I collected sufficient for analysis. They presented all the characters of phosphate of iron, and when I had calcined them with carbonate of soda, it was easy to separate the acid from the base; indeed, the product of the calcination having been treated with distilled water, I obtained a yellow residue of oxide of iron and an alkaline solution, which, when neutralised, gave an abundant precipitate, with

a mixture of ammonia, hydrochlorate of ammonia, and sulphate of magnesia. This, therefore, was phosphoric acid, and the substance was crystallised phosphate of iron.

As we are acquainted with only one species of crystallised phosphate of iron, the prisms in question could only be *vivianite*, an interesting mineral which occurs in certain sedimentary soils.

The coloration of the bones of the Cemetery of Eumont is now easily explicable; they must have remained in a ferruginous water; the oxide of iron introduced by capillary attraction having come in contact with the phosphate of lime of the bones, had formed the coloring matter, phosphate of iron, the presence of which I proved.

This formation of a mineral in an organised body reminds us of an observation made by M. Schlossberger, of an ostrich which had died suddenly, and in the stomach of which were found two nails, surrounded by a blue, unctuous substance, which the author found to be composed of phosphate of iron in the proportions which constitute *vivianite*.

I could not learn the precise age of these bones; it was supposed to be about two centuries, but had these been some centuries older, the fact mentioned in the note would equally lead to the conclusion that *vivianite* is of quite modern formation, and that it may be produced as often as phosphoric acid, which abounds in the state of phosphate, occurs in favorable conditions in presence of oxide of iron, which is found everywhere.

Comptes Rendus, No. 26, Dec. 24th, 1855.

On a TITANIFEROUS PERIDOT, from PFUNDERS, in TYROL.

By M. A. DAMOUR.

THE mineral which forms the subject of this note, and which I observed, for the first time, in M. Adam's collection, was designated by the name of *ferriferous garnet*, from Pfunders, in Tyrol. It occurs in nodulous masses, engaged in a rock of serpentine talc, traversed by veins of laminar carbonate of lime, and might, at first sight, easily be confounded with certain amorphous garnets. M. Adam having been kind enough to entrust to me his specimen for the purpose of studying its characters, I very soon ascertained that this mineral, which is essentially formed of silica and magnesia, with a little titanitic acid, oxide of iron, and water, could no longer be classed among the garnets.

Its colour is brownish red, cinnamon red; reduced into small pieces, it is completely transparent; its dust is orange yellow.

It scratches glass, and is scratched by quartz.

Its form, which I could only determine with incomplete crystals disengaged, by means of acetic acid, from the crystalline calcareous carbonate in which they were enveloped, presents faces which, from their external aspect, seem to indicate a rectangular prism.

The analysis gave the following results:—

		Oxygn. Proportion.
Silica	0·3630	0·1885 1
Titanic acid	0·0530	0·0211 „
Magnesia	0·4965	0·1950 1
Oxide of iron	0·0600	0·0179 „
Oxide of manganese	0·0060	0·0013 „
Water	0·0195	0·0173 „
		·9980

We see, in this combination, that the silica and the magnesia are nearly in the proportion of 1 : 1 ; but it appears to me very difficult to account for the part which the titanic acid, oxide of iron, and water may play in it.

Comptes Rendus, No. 26, Dec. 24, 1855.

METALLURGY.

NOTE on the PREPARATION of URANIUM.

By M. EUGENE PELIGOT.

I HAVE the honor of exhibiting to the Academy some pieces of uranium, fused at a high temperature.

When I made known this metal in the isolated state, in 1842, I showed, that by treating proto-chloride of uranium with potassium, it is obtained partly in black powder, and partly in the agglomerated state, under the form of plates, having a metallic lustre similar to that of silver ; but, as this operation was performed in a platinum crucible, the formation of an alloy of uranium and platinum might be feared. I proved, indeed, the presence of a small quantity of platinum in the portions possessing a metallic lustre. I tried several times at that period to produce uranium in non-metallic crucibles ; but these were constantly broken by the sudden elevation of temperature which the reaction developed.

The facility with which sodium is now procured, owing to the valuable improvements introduced by M. H. Deville into the preparation of that metal, has led me to resume my experiments, substituting sodium for potassium. After several fruitless attempts, I succeeded in obtaining uranium, pure and fused, with truly metallic characters, by proceeding in the following manner :—

Into a glazed porcelain capsule is introduced the quantity of sodium necessary for decomposing the green proto-chloride of uranium prepared, as I have indicated, by submitting one of the oxides of that metal to the simultaneous action of chlorine and charcoal. The sodium is covered with very dry chloride of potassium, and then, with a mixture of this same salt, and the chloride of uranium to be decomposed ; the crucible, fitted with its cover, is placed in an earthen crucible, which is filled with charcoal dust, and which is also closed with an earthen lid. The addition of the chloride of potassium is for the purpose of rendering the reaction less sudden and violent.

The crucible is heated until the reaction is manifested ; this is known by the noise which is heard at this time ; it is immediately placed in the wind-furnace, and heated to white redness for fifteen or twenty minutes ; when it is cold, we find in the porcelain crucible a fused scoria, which contains several globules of uranium.

Thus prepared, this metal possesses a certain degree of malleability ; although hard, it is easily scratched with steel ; its color resembles that of nickel or iron. It acquires in the air a yellowish tint, owing to a slight superficial oxidation. Heated to redness, it suddenly presents a violent incandescence, and is covered with a bulky black oxide, in the interior of which is found the still unoxidised metal, if the action of the heat has been stopped in time.

Its density is very remarkable ; it is equal to 18.4. Thus, next to platinum and gold, it is the heaviest body known. This specific gravity justifies, also, the high equivalent which I have attributed to this metal.

I have proved that uranium may likewise be obtained by means of the same green chloride and aluminium. Its isolation by this reaction is due, doubtless, to the great volatility of the chloride of aluminium. I intend to continue the study of this metal, whose physical and chemical properties differ much from those of other metals.

Comptes Rendus, No. 3, January 21, 1856.

ORGANIC CHEMISTRY.

NEW RESEARCHES on METHYLURAMINE and its DERIVATION.

By M. DESSAIGNES.

In a Note which I had the honor of presenting to the Academy about two years ago (*See THE CHEMIST*, Vol. I, 1853-4, page 594), I made known under the name of *methyluramine*, a very powerful base, which is produced by the action of oxide of mercury on creatine and on creatinine. This alkali, the formula of which is $C^4 H^{14} N^6$, may be considered as an intimate combination of urea and methylamine with elimination. Creatine, in its turn, may be represented by glycollate of methyluramine, minus water and sarcotone which is derived from it, would then be the glycollic amide of methylamine. If this view of the constitution of these bodies is accurate, we should be able easily to extract methylamine from it. This is, in effect, what I have found.

The salts of methyluramine, heated with a solution of potassa, disengage abundant alkaline vapors, which I collected in hydrochloric acid. I evaporated the saline mixture thus obtained, and I separated the greater part of the sal-ammoniac with anhydrous alcohol. The salt soluble in alcohol crystallises in brilliant plates. I prepared the chloro-platinate, which I purified by several crystallisations ; in order to obtain methylamine with creatine, I heated the latter with soda lime : I prepared and purified the platinum salts as previously. Sarcotone, treated by the same process, also disengages methylamine ; but I ob-

tained it, moreover, by means of another reaction, which is remarkably clear.

Sulphate of sarcotone, dissolved in water and heated with peroxide of lead, was decomposed with a brisk effervescence; the liquor acquired an alkaline reaction and disengaged a peculiar, staphylyng odor; a sulphate was formed which was decomposed with chloride of barium, and the hydrochlorate was mixed with chloride of platinum. The chloro-platinate crystallised in small, very brilliant, hexagonal tables of great purity.

Finally, creatine oxidised by nitric acid, with heat, gives rise to ammonia and also to an alkali already noticed by M. Chevreul, who did not analyse it. This alkali is also methylamine; but the chloro-platinate obtained by this method is difficult to separate entirely from the salt of platinum and ammonia which accompanies it.

The following analytical results confirm the foregoing data:—

	I.	II.	III.	IV.		Calculation.
C .	5.20	4.82	4.67		C ² .	5.06
H .	2.81	2.70	2.74		H ¹² .	2.53
N .	5.43	5.42	5.15		N ³ .	5.90
Pt .	41.22	41.26	41.80	41.96	Pt .	41.56
Cl .	44.93				Cl ⁶ .	44.93

No. I. was prepared with sarcotone and PbO^2 , II. with methylamine and potassa, III. with creatine and nitric acid, and IV. with creatine and soda lime.

Puce oxide of lead oxidises creatine with the addition of sulphuric acid; on being heated, this acid is gradually saturated. The sulphate thus formed, was converted into hydrochlorate and the latter into chloro-platinate, which crystallises in beautiful orange prisms. This salt gives by analysis the following results:—

						Calculation.
C .	.	8.88	C ⁴ .	.	.	8.60
H .	.	2.96	H ¹⁸ .	.	.	2.87
N .	.	14.35	N ⁶ .	.	.	15.05
Pt .	.	34.77	Pt .	.	.	35.30
Cl .	.	38.06	Cl ⁶ .	.	.	38.18

The formula calculated is that of the chloro-platinate of methyluramine: the crystallised oxalate effloresced at 100°C . (212°F .), and lost 12.95 per cent. of water; besides, the base which I isolated presented all the properties of methyluramine. However, I should say, that, notwithstanding repeated crystallisations, I could not obtain the chloro-platinate and oxalate with the same apparent forms as the corresponding salts of methyluramine prepared with oxide of mercury.

An aqueous solution of creatinine, traversed by a current of nitrous gas, effervesces and speedily turns brown, and then becomes turbid; after some hours, an abundant deposit is formed, consisting of small, compressed, yellowish crystals, which, after a long time, and moistened with their mother liquor, are converted into large crystals. This is the nitrate of a new and very feeble base. Water alone partially

I.	Calculated		II.	Calculated		III.	
C... 34.46	C ¹² .. 33.64	C .. 25-18	C ²⁴ .. 24.40	C .. 18-06	C ²⁴ .. 19.09		
H... 5-24	H ²⁰ .. 4.67	H .. 5.50	H ¹⁸ .. 4.90	H .. 2.83	H ¹⁸ .. 2.63		
N .. 38.14	N ¹² .. 39.29	N .. 27.40	N ²⁴ .. 28.40	N .. "	N ²⁴ .. 15.27		
	O ⁸ .. 22.44	O .. "	O ¹³ .. 24.40	O .. "	O ¹⁸ .. 13.09		
		Cl.. 17.95	Cl ⁶ .. 17.90	Pt.. 26.34	Pt ³ .. 26.86		
				CL.. 29.31	CL ¹⁸ .. 29.04		

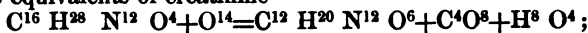
$$2 (\text{C}^{12} \text{H}^{20} \text{N}^{12} \text{O}^6) 3 (\text{H}^2 \text{Cl}^2) + \text{Aq}$$

The new alkaloid, heated to 100° C. (212° F.) with an excess of hydrochloric acid, is easily decomposed. The products of the reaction are :—oxalic acid, sal-ammoniac, and a body crystallising in long, brilliant prisms or folia, dissolving slowly in cold water, on the surface of which it often floats, very soluble in hot water and sparingly so in ether, possessing a disagreeable, metallic taste, fusible, volatile, without decomposition, burning with a flame and leaving no residue, presenting a feeble acid reaction to test paper ; it does not precipitate the salts of lime, baryta, lead, copper, and zinc ; chloride of mercury, nor nitrate of silver in dilute solution. This body presents, therefore, the characters of the substance discovered by Liebig, and which accompanies sarcotine in small quantity. To the description given of it by that celebrated chemist, I can make, at this moment, only one addition. This body, in rather concentrated solution, precipitates nitrate of silver and nitrate of mercury. The following is the analysis of it :—

C	.	.	37.61	C ⁸	.	.	.	37.50
H	.	.	3.69	H ⁸	.	.	.	3.12
N	.	.	21.57	N ⁴	.	.	.	21.87
O	.	.	" "	O ⁶	.	.	.	37.51

We may express as follows the relations which exist, on one hand, between the creatinine and the insoluble base, and on the other, between this base and Liebig's body :—

Two equivalents of creatinine—



the insoluble base—



In the reaction of the nitrous vapor on creatine a small quantity of white powder is formed, the identity of which with the foregoing base I recognised, inasmuch as, heated to 100° C. (212° F.), with hydrochloric acid, it produced Liebig's body. Finally, I obtained this same body, by evaporating, under a bell glass and over lime, the acid mother liquor from which the crystals of the nitrate of the new base had been separated.

Comptes Rendus, No. 27, December 31, 1855.

On the VOLATILE OIL of "PTYCHOTIS AJWAN."

By R. HAINES, M.B., Professor of Materia Medica in the Grant Medical College, Bombay.

THIS umbelliferous plant grows abundantly in Rajpootana and in various other parts of Central India. The fruit is short, compressed laterally, and in shape, size, and appearance, very closely resembles that of *Conium maculatum*. It has a powerful and agreeable odor of thyme. The process of extracting its volatile oil is well known to the natives, and is practised pretty extensively in the state of Judore and the neighboring territories. The oil is used by the native doctors as a carminative, under the name of *Ajwa ke tel*, or Ajwa oil. This, as sold in the Bombay bazaars, is of a dark amber-yellow color, somewhat viscid, and not pouring freely, as if loaded with resin or fixed oil. It has a pure odor of thyme.

Re-distilled with water, it yielded, after cohobating the water several times, a little more than one-fourth of its bulk of a limpid bright yellow oil. The residue was a dark orange-yellow, viscid, oily liquid, almost free from odor.

This residue was sparingly soluble in alcohol, even when boiling, and itself dissolved an appreciable quantity of alcohol. On evaporating the alcoholic solution, the oil was obtained unchanged in its properties. It did not appear to contain resin. It was more soluble in ether. Boiled with potassa it formed a soluble soap. Under a heat gradually increasing to near redness, it was converted into volatile liquid and gaseous products, giving off the pungent odor of acrolein. A small residue of carbon was left in the retort. Warmed with solution of pernitrate of mercury, it did not solidify or undergo any material change, beyond becoming of a darker color and somewhat more viscid. It consisted, therefore, essentially of a siccative fixed oil,—probably poppy oil,—with which the volatile oil had been adulterated.

The rectified oil, distilled by itself, began to boil at 350° F., the boiling point slowly rose to 366°, at which about one-third came over, and then advanced more rapidly to 459°. A small dark-colored residue was left in the retort.

The product by repeated fractional distillation was separated into two portions, one boiling at 353°, the other at 440°—450°; the former amounting to about two-thirds, the latter to one-third of the whole.

The more volatile portion was colorless, refracted light strongly, and had a peculiar, sweetish, smoky odor, reminding somewhat of caraway, but entirely distinct from that of thyme. Digested over powdered chloride of calcium, and re-distilled, it retained the same boiling point. Re-distilled over hydrate of soda, its boiling point was reduced to 347°, at which it remained constant. Its specific gravity at 80° was 0·845.

Burnt with oxide of copper, the following results were obtained :—

- I. 6·69 grains gave 6·43 water.
 II. 8·62 " " 8·20 " and 28·51 carbonic acid.
 III. 7·59 " " 7·35 " " 24·92 " "

			Calculated.	Found.	
			I.	II.	III.
20 C	120	89·55	—	90·20	89·54
14 H	14	10·45	10·68	10·57	10·76
134			100·00	100·77	100·30

It is, therefore, isomeric if not identical with cymole— $C^{20}H^{14}$.

The portion which boiled at 440°—450° had a yellowish color, which could not be removed by repeated distillation. Its odor was that of the original oil, but more concentrated. When kept for several days, it did not crystallise; but on throwing into it a minute fragment of the stearoptene previously deposited from the oil, crystals began to form immediately, and in a few hours it had become almost wholly converted into nearly colorless crystals, forming flattish tables of a rhomboidal shape, surrounded by a dark yellow oily liquid. By pressure between folds of blotting paper, the crystals were obtained dry and pure.

They were then found to be identical with the crystals sold in the bazaar as *Ajwa ka phul*, or flowers of Ajwa.* They have a powerful odor of thyme, and a hot and very pungent taste; are insoluble in water, but freely soluble in alcohol, ether, and volatile oils. At 127°, F. they melt to a colorless liquid, which begins to boil at 439°; but the temperature quickly rises to 447°, at which the whole comes over. The distilled liquid is colorless, not so strongly refractive as the more volatile liquid, and it may be kept for weeks in closed vessels in a fluid state, until a fragment, however minute, of its crystal is thrown in, when crystallisation instantly begins in all directions throughout the liquid. The latter was neutral to test-paper. Its specific gravity at 78° was 0·939.

* I have not been able to discover by what method the natives contrive to obtain the stearoptene from the oil; it is probably so loaded with it as to crystallise out on dropping in a fragment ready formed, without its being necessary to re-distil the oil.

Sulphuric acid combines with it without charring, forming a colorless or pinkish crystalline mass, soluble in water and yielding a soluble salt with baryta.

Nitric acid, aided by heat, oxidises it rapidly, and gives rise to the production of gamboge-yellow, sticky resin.

A crystal thrown into nitro-muriatic acid causes the instant formation of a dark green color, which passes after a few minutes into brown, with the formation of a resin.

It did not combine with hydrate of soda, or with a strong solution of potassa. Heated with solid potassa, it yielded no ammonia.

It was analysed by combustion with oxide of copper.

I. 5.31 grs. yielded 4.57 of water. (The carbonic acid was lost.)

II. 5.73 " " 4.93 " and 16.75 of carbonic acid.

III. 6.67 " " 5.72 " 19.43 " "

Its composition is, therefore, as follows:—

Calculated.			Found.		
			I.	II.	III.
20 C	120	80.00	—	79.72	79.45
14 H	14	9.33	9.56	9.56	9.53
2 O	16	10.67	—	10.72	10.02
	150	100.00		100.00	100.00

It is evidently, therefore, identical with the stearoptene of the oil of thyme, or thymole, described by M. Lallemand in the *Comptes Rendus* of Sept. 26th, 1853. I could not observe, however, the property which M. Lallemand assigns to thymole,—of combining with caustic alkalies. The reaction with nitro-muriatic acid is also, I believe, new.

Oil of Ajwa, then, combines the properties of the oils of cumin and thyme, having the hydrocarbon of the one, and the oxidised oil of the other, thus:—

$C^{20} H^{14}$ = Cymole —Hydrocarbon of Ajwa oil;

$C^{20} H^{14} O^2$ = Thymole—Stearoptene of ditto;

and it thus presents an exception to the general relation of the components of volatile oils, the stearoptene being simply the hydrocarbon *plus* oxygen, without the separation of any portion of the hydrogen.—*Quarterly Journal of the Chemical Society.*

INORGANIC CHEMISTRY.

RESEARCHES on the PRODUCTION of NITRIC ACID.

By M. S. DE LUCA.

CAVENDISH first showed that nitrogen and oxygen may be directly combined under the influence of the electric spark, when they are humid, or, better still, when they are in contact with both water and an energetic base; they thus produce a nitrate. This experiment, in

fine, is only the production of ozone—modified oxygen—which, with the nitrogen, causes the production of nitric acid.

Schönbein's beautiful experiments, confirmed by the researches of MM. Marignac and De la Rive, Fremy and Ed. Becquerel, have made us acquainted with the singular properties of ozone, with which the explanation of several natural phenomena of high importance is connected.

M. Houzeau, by treating binoxide of barium with monohydrated sulphuric acid, obtained oxygen, *nascent* oxygen, capable of completely burning the elements of ammonia, of liberating chlorine and iodine from hydrochloric acid and iodide of potassium, of oxidising silver, &c., of acting, in a word, like ozone itself.

M. Cloëz has recently demonstrated, by very accurate experiments, that nitrogen and the oxygen of the air, under the influence of porous matters and alkalies, and in the total absence of any nitrogenous or ammoniacal matter, may combine to form nitric acid and nitrates.

By passing humid ozonised air very slowly for about three months, October, November, and December, 1855, principally during the night, over potassium and pure potassa, I obtained nitrate of potassa, separable from the alkaline solutions by crystallisation. The entire volume of air employed was from 7000 to 8000 litres, (quarts). The air before being ozonised in a large flask containing phosphorus under a layer of water, passed, over carded cotton and into an apparatus of a peculiar form, over potassa and sulphuric acid; it was thus freed from matters in suspension and from nitrogenous substances.

M. Ubaldini and I verified the sensibility of this ozonised air, and we found, by means of starched paper that it could *easily* liberate the iodine contained in 1-100,000th of a milligramme of iodide of potassium. These results confirm those which M. Schönbein obtained by another process.

Former experiments, which I intend to repeat, have shown me that pure potassa, over which I passed, in summer and during the day, a certain quantity of air, did not contain nitrates; that, on the contrary, in winter and during the night, the air did produce nitrates with potassa; that air, agitated and renewed every day for several months, in presence of alkalis, could likewise produce nitrates. But there are so many difficulties and so many causes of error in these experiments, that I put them forward only as trials to be followed up and to be studied.

I shall profit by the advice kindly given me by M. Balard, to examine the influence of the agitation of a solution of potassa in a limited volume of air, not renewed with relation to the formation of the nitrates, the motion being effected by means of a steam-engine.

The great importance of porous matters in the formation of the nitrates, is demonstrated by the beautiful researches of M. Cloëz; but might not the porous bodies act on the alkalis by the production of ozone? And would the air itself, heated beyond 100° C. (212° F.), or even to that temperature, produce the same effects under the influ-

ence of porous bodies, and in the presence of the alkalis? Is it immaterial to experiment in summer or in winter, during the day or during the night—in darkness or in light—at an uniform temperature or at a variable temperature? Is ozone produced more easily in winter and during the night, than in summer and during the day? These are difficult questions, which can be solved only by long sustained study. They require the assistance of several chemists, and the high protection of the learned bodies.

Comptes Rendus, No. 27, Dec. 31, 1855.

On the COMPOSITION of BANK-NOTE SLAG.

By F. W. GRIFFIN, Ph.D., Director of the Bristol School of Chemistry.

IN Mr. Tomlinson's excellent paper on the Manufacture of Smalt, given in the *Pharmaceutical Journal*, vol. x., p. 503, reference is made to the blue semi-vitrified slag, or ash, of bank notes. I lately received from Professor Brande a fine specimen of this "relic of departed worth," and deeming it worthy of closer investigation, I induced Mr. D. Fry (a gentleman working in my laboratory) to undertake its analysis. This he performed with great care, under my constant supervision. Before giving the results, I will mention certain points of interest in the history of the substance, which I owe to the courtesy of Matthew Marshall, Esq., of the Bank of England, who kindly showed me all the matters described.

It is well known that the Bank rarely issues notes a second time, even if they are returned clean and new. They are, however, preserved for ten years, in case of reference being required; and as they are paid in, at Threadneedle Street and the branches, at the rate of 30,000 per day, they accumulate to a surprising extent. Each day's returns are put by in a box, with the date duly ticketed on its front, and these are ranged on shelves in a series of small rooms in the basement of the building, facetiously designated the "Bank Library." Once a year an *auto-da-fé* is held of those notes whose term of grace has expired, a bonfire being made of them in a kind of furnace or kiln in one of the court-yards. This kiln is octagonal in shape, and about nine feet in diameter by five in height. It is open at top, and the base or hearth is solid, the draught being obtained by numerous perforations in the brick-work of the sides. It is enclosed in a large iron cage, to prevent fragments of the notes from being carried away by the current of heated air. The firing is commenced by kindling some loose notes, and scattering them lightly over the hearth; the bundles are afterwards thrown in pell-mell. The combustion lasts the greater part of two days; and minute as must be the portion of ash yielded by each note, the total amount from the nine millions consumed becomes very considerable, covering the hearth to some depth. Previous to 1821, a little *smalt* was used in the manufacture of the paper em-

ployed, and the silica and potassa, of which that is mainly composed, caused the ash to agglomerate into masses, or even occasionally to fuse into a glassy slag, colored intensely blue by the oxide of cobalt. The use of smalt being discontinued, this product is no longer obtained. At present the ash is much smaller in amount, being simply due to the small quantity of earthy and saline matter naturally contained in the tissue of the paper, and it is white and flocculent like the ashes of vegetable substances in general.

My specimen (which weighs nearly half a pound) is, in appearance, a porous, friable mass of a dull dark blue color, with streaks and patches of yellow and white. Here and there are portions of a vivid blue, and in some places it is fused into a blebby, opaque, and nearly black glass. A large specimen in the laboratory of the Royal Institution has been completely fused, having moulded itself, with a smooth surface, to the shape of the hearth. This is about an inch in thickness, and very hard and heavy.

To obtain an average sample for analysis, about 1000 grains were taken from different parts of the mass, ground into fine powder in a large agate mortar, and lixiviated by stirring up with water. The portions which readily subsided were re-ground, till the whole was obtained in a state of impalpable division. The liquid was evaporated to dryness (with the powder) in a platinum basin, the residue thoroughly intermingled, and the various portions taken for analysis from this homogeneous sample were feebly ignited before weighing.

I may remark that the above method is indispensable for the accurate analysis of rocks and minerals. If they are merely ground, with any amount of labor, there are always particles too coarse for complete decomposition by the flux; and if the lixiviating water is thrown away, an equally serious error is introduced, as it almost invariably dissolves sufficient of certain constituents of the substance to leave on evaporation a white crust all over the surface.

A careful qualitative examination (after fluxing with carbonate of soda) showed the presence of the various substances enumerated below, and the *absence* of appreciable traces of baryta, strontia, chromium, cadmium, bismuth, zinc, antimony, or tin. In searching for the two latter metals, the sulphides soluble in sulphide of ammonia were treated with carbonate of ammonia, according to Bloxam's method (*Q. Journal Chem. Soc.*, v. 126). A portion of the powdered slag was also boiled for some time with dilute nitric acid. There was no trace of effervescence, or the least turbidity on adding nitrate of silver to the clear liquid; hence no carbonic acid or chlorine were present.

Boiled with water, the liquid gave (without filtration) strong reactions of lime and sulphuric acid; gypsum had therefore been dissolved out, probably with a little alkaline sulphate, as the indications of sulphuric acid seemed more than proportionate to those of the lime.

The quantitative analysis presented peculiar difficulties; the slag combining, as it does, the complex composition of an ore of cobalt with

that of a vegetable ash. It may therefore be worth while to describe the several operations in detail. Exception may be taken to certain points in the method pursued, but I am convinced that the results are as near the truth as the nature of the substance permits.

Great care was bestowed throughout on the washing and weighing of the precipitates, and the amount of the filter-ash was accurately known and deducted.

A.—For the general analysis, 94·913 grs. were fluxed for an hour and a half with three times their weight of carbonate of soda.* The fused lump (detached from the crucible by placing the latter while still ignited on a mass of cold iron, as recommended by Fresenius) was heated by a water-bath with dilute hydrochloric acid in a covered beaker for twenty-four hours. The residuary silica, after thorough washing with hot water, weighed 41·815 grs. As it was heavy and gritty, and presented a shade of blue, it was refluxed with carbonate of soda at a strong heat. The solution obtained from this was colorless, but on evaporation to dryness, yellow efflorescences were formed on the saline mass; so that traces of cobalt, &c., were further obtained from this silica. Washed with hot water till no stain was produced on platinum, it weighed 41·009 grs. The difference (·806 gr.) was not very considerable, and was without doubt in small part due to the slight unavoidable waste in emptying out and mixing up such a substance as ignited silica. I have ventured to add ·1 gr. to the second weighing, to partly compensate for this loss, making the residuary silica=41·109 grs.

Owing to the presence of the volatile chloride of arsenic, the liquid could not be evaporated to dryness for the separation of the soluble silica till after precipitation with sulphuretted hydrogen. A slow current of that gas was passed through the liquid for seven or eight hours. The precipitate first formed was reddish-brown (lead and copper), then dirty-yellow, becoming finally pure yellow. From the slow rate at which the arsenic went down, it would appear as if at least a portion existed in the state of arsenic acid. The beaker was covered and allowed to stand at rest for twenty-four hours, then warmed, filtered, and the residue well washed. The latter was heated several times with solution of sulphide of potassium, the resulting liquid filtered off

* A gauze-flame from a cylinder about two inches in diameter answers best for the first hour. The materials slowly agglutinate, slightly shrinking in bulk, but without the smallest projection; and on subsequently applying the full power of a Herapath blowpipe, worked by a hydrostatic cistern, giving a pressure of eighteen or twenty inches of water, the whole melts down into tranquil fusion. A gauze-flame does not produce a sufficiently high temperature to effect complete decomposition with carbonate of soda alone, which is far preferable to the mixture with carbonate of potassa, as the latter can hardly be obtained free from silica. I have repeatedly fluxed siliceous minerals in this way, with the mixture pressed down to within a tenth of an inch of the edge of the crucible, and had barely a speck projected on the cover. When the mass is in perfect fusion, curious spiral figures, very similar to those of the chromatrope, keep revolving inward from the sides to the centre.

from the undissolved metallic sulphides (*b*), and super-saturated with hydrochloric acid, which produced a copious yellow precipitate of tersulphide of arsenic, mixed with free sulphur (*a*).

(*a*) The above precipitate was collected on a weighed filter, thoroughly washed, placed in a small beaker, covered with a porcelain lid, and dried in a steam oven till the weight remained constant. This was 38.552 grs. As much of this as possible (found by re-weighing to be 37.91 grs.) was detached from the filter and carefully heated with strong nitro-hydrochloric acid in a covered beaker, till all the sulphur was acidified. It had been intended to precipitate this sulphuric acid by baryta, deducting the amount of sulphur so determined from the joint weight, to arrive at that of the arsenic, but a minute loss of liquid rendered this course impracticable. A considerable excess of ammonia, and subsequently sulphate of magnesia, were therefore added instead, and the whole set aside for twenty-four hours. The granular precipitate (all crystalline) of ammonio-arsenate of magnesia was collected on a weighed filter, washed with a mixture of ammonia and water, and dried at 212°. It weighed 3.45 grs., which, corrected for the portion of precipitate left adhering to the filter, gives a per-centage of 1.926 of arsenious or 2.237 of arsenic acid.

(*b*) The small portion of undissolved sulphides was treated with nitric acid, the liquid filtered, evaporated nearly to dryness, to get rid of the free acid, mixed with alcohol, and precipitated with dilute sulphuric acid. The sulphate of lead weighed .7996 gr. The oxide of copper was separated by boiling the filtrate with caustic soda. After weighing, it was moistened with nitric acid and re-weighed, when it gave .5393 gr.

The *original solution* was evaporated to dryness on the water-bath, and the residue heated to 300°—320° F. in a Taylor's hot-air oven. It was then treated with hydrochloric acid and diluted. The silica, after thorough washing, weighed 8.8176 grs. During the subsequent steps of the analysis, small portions were further obtained, jointly weighing .7046 gr. The total amount of silica is therefore (residuary) $41.109 + (\text{soluble}) 8.8176 + .7046 = 50.6312$ grs., or 53.845 per cent.

The filtrate from the silica was heated with excess of acetate of soda. An abundant yellowish-white precipitate of perphosphate of iron was produced, which was thoroughly washed with hot water. It weighed (after twice moistening with nitric acid and re-igniting) 7.26 grs.

The phosphoric acid of the slag being in excess of the iron, its further amount was then determined. 15.23 grs. of fine iron wire were boiled with nitro-hydrochloric acid, and the solution added to the liquid; excess of acetate of soda was poured in, and the whole boiled. The liquid was left quite colorless, as in the preceding operation. The precipitate, treated like the last, weighed 23.2923 grs., which is 1.5353 grs. above the weight of sesquioxide that the iron would yield—the increase being due to phosphoric acid. Both these precipitates were

carefully tested before the blowpipe with borax, and on platinum foil with carbonate of soda and a little nitre. The former gave simply a dirty brown bead, and the latter a grey mass, showing that no traces of cobalt or manganese had been thrown down. This excellent method of separating phosphoric acid seems therefore equally admissible in presence of a variety of metals.

Solution of sulphite of soda with an excess of caustic soda, was then added to the main solution, which was boiled for some time, and the liquid (*b b*) filtered off from the dense black precipitate (*a a*).

(*a a*) The precipitate was dissolved in boiling nitro-hydrochloric acid, slightly supersaturated with ammonia, and a little succinate of ammonia added to separate any portion of iron which it was presumed had been previously used in excess; but none was present. Hydrocyanic acid was added, and afterwards caustic soda, till the precipitated cyanides of nickel and cobalt were redissolved. The liquid was then boiled till it lost the smell of hydrocyanic acid, and freshly-precipitated yellow oxide of mercury was added, the boiling being continued. The precipitate was filtered off, thoroughly washed, and ignited in a porcelain crucible till its weight remained constant. This protoxide of nickel was = 6023 gr.

To determine the cobalt, Wöhler's method was pursued. The filtrate was nearly neutralised with nitric acid, and a solution of sub-nitrate of mercury added as long as a precipitate was formed. This (which was rather copious) was ignited with access of air, and gave, .7429 gr. proto-sesquioxide of cobalt, equivalent to .6935 gr. of protoxide, or .731 per cent. It was attempted to determine the manganese, but no ponderable quantity could be separated.

(*b b*) The liquid was next examined. Excess of hydrochloric acid and a little chloride of potassa being added, it was boiled to destroy any organic matter, and the alumina was then precipitated with a slight excess of ammonia; set aside for twenty-four hours before filtering; washed with hot water till no appreciable stain was left on platinum, and ignited. It weighed 3.453 grs. Though Fresenius implies the contrary (*Quant. Anal.*, p. 301), the above method seemed to effect complete separation of alumina from the oxides of cobalt and nickel.

No excess of iron having been used (as shown by its absence in the precipitate *a a*), it was resolved to try whether phosphoric acid might not be further contained in the liquid. 18.342 grs. iron wire were therefore peroxidized by nitro-hydrochloric acid, added to the liquid, and precipitated by ammonia with the same precautions as before. The weight was 27.414 grs., or 1.212 grains beyond the calculated amount of sesquioxide. The total amount of phosphoric acid would therefore be 2.7473 grs. (1.5353 + 1.212 grs.), or 2.8934 per cent., exclusive of that contained in the perphosphate of iron. It is not easy, however to see how phosphoric acid could co-exist with lime in an alkaline solution, unless, indeed, the large bulk of the liquid containing sal-ammoniac kept a portion of phosphate of lime dissolved.

The lime was then precipitated from the filtrate by oxalate of ammonia, and the magnesia subsequently by phosphate of soda. The lime-precipitate was twice moistened with carbonate of ammonia, and feebly ignited. The last two weighings were almost identical. The weight was 18.1226 grs.=to 10.6926 lime per cent. The phosphate of magnesia weighed 2.5998 grs.=.9843 p. c. of magnesia.

B.—To determine the amount of the *alkalies*, 59.635 grs. of slag were intimately mingled with six times their weight of finely-pulverised fused hydrate of baryta, which had been previously found to contain only mere traces of saline impurities. The mixture was very gently heated at first, but gradually more and more strongly up to full ignition. The mass was heated with dilute hydrochloric acid, the residue filtered off and thoroughly washed, and the liquid precipitated by carbonate of ammonia mixed with caustic ammonia. The filtrate (with the copious washings) was evaporated to dryness in a platinum basin, and ignited; the residue redissolved; mixed with a little carbonate of ammonia, and filtered; then again evaporated to dryness, redissolved, filtered to separate a small amount of insoluble matter; and lastly evaporated to dryness, and ignited for the third time. The mixed alkaline chlorides weighed 18.9768 grs. They were dissolved in water; the solution evaporated nearly to dryness with excess of bichloride of platinum; the residue treated with strong alcohol, and washed with the same till a few drops, allowed to evaporate spontaneously on a slip of glass, began to show only yellow octohedra under the microscope. (This, by the way, is the best test of the completion of the washing of a precipitate, either of ammonio or potassio-bichloride of platinum, as their washings always leave some stain, neither of those compounds being wholly insoluble even in ether-alcohol; but the more soluble bichloride and sodio-bichloride of platinum give totally different crystals, of a prismatic or acicular form.) The potassio-bichloride of platinum, dried at 212° weighed 36.435 grs., giving a per-centage of potassa=11.775, and of soda (by difference)=2.543.

C.—There then remained simply to determine the amount of sulphuric acid. As the carbonate of soda I had by me was not absolutely free from sulphate, I deemed it sufficient to boil the finely-pulverized slag for a length of time with much diluted hydrochloric acid, filter off the liquid,* and precipitate with chloride of barium. 28.335 grs. so treated gave 1.5748 grs. of sulphate of baryta, equivalent to 1.907 per cent. of sulphuric acid.

The above results, when tabulated, gave the following as the

* Considerable annoyance is often experienced in the washing of similar earthy residues, during the analysis of soils, rocks, &c., from the finely-divided substance beginning to pass through the paper after a certain time, rendering the liquid more and more turbid. This can be entirely prevented by adding a few drops of hydrochloric acid to the washing water, which then continues to pass as bright as at first.

COMPOSITION OF BLUE BANK-NOTE SLAG.

Silica	53·345
Alumina	3·638
Lime	10·693
Magnesia	·984
Potassa	11·775
Soda	2·543
Cobalt, Protoxide	·731
Nickel „	·635
Lead „	·620
Copper „	·568
Manganese „	traces
Perphosphate of iron	7·649
Phosphoric acid	2·893
Arsenious acid	1·926
Sulphuric acid	1·907

 99·907

The most striking feature of the analysis is the singularly large amount of foreign metals forming the mere impurities of the smalt (arsenic, nickel, lead, and copper), as compared with the cobalt itself. *Pharmaceutical Journal.*

 On a NEW MEANS of OBTAINING SILICIUM.

Letter from M. WÖHLER to M. DUMAS.

“Göttengen, Jan. 29th, 1856.

“ALLOW me to call your attention to an observation which has given me pleasure, because it is one of the consequences of the beautiful labors of M. Saint-Claire Deville on aluminium and silicium. In preparing aluminium by means of cryolite ($3\text{NaF} + \text{AlF}_3$) according to the new process of M. Rose (*See THE CHEMIST*, February, 1856, p. 266), I tried to employ Hessian crucibles, instead of iron crucibles. I thus often obtained globules of aluminium, covered and traversed with hexagonal crystals of a black matter, with a metallic lustre. By treating this aluminium with hydrochloric acid, it was easy to obtain this matter under the form of bractæ with a metallic lustre, very similar to graphite, but with a bluish tint of lead. This was silicium in the remarkable form discovered by M. Deville.

“On reflecting on the process by which, in this case, the silicium is reduced under this form, it appeared to me probable that, by contact of the alkaline fluoride with the silica of the crucible, double fluoride of silicium and sodium is formed, and that it is from this combination that the silicium is reduced by the aluminium. Indeed, this idea has been perfectly confirmed, and I am now master of a process by which silicium may be obtained at will in this crystallised state. We have only to fuse together aluminium with an excess of double fluoride of silicium and potassium ($3\text{KF} + 2\text{SiF}_3$) in an ordinary crucible at a

heat nearly sufficient for fusing silver. After cooling, on breaking the crucible, we always find, in the midst of the fused salt, a very round button, which is very brittle, of a very crystalline texture, and of a deep iron color. This appears to be the compound of silicium and aluminium already observed by M. Deville, containing in this case a very large quantity of aluminium in the state of graphite. It contains, according to the duration of the fusion, from 75 to 80 per cent. of it. It is easily obtained by treating the broken button with hydrochloric acid. Thus, thanks to M. Deville, we are now enabled to study more closely the properties of this remarkable body. I very much regret that, from the want of aluminium, I am unable to pursue these researches."

M. Dumas said when this letter reached him he had in his hand a note from M. Deville in which that skilful chemist gave the results of his new researches on silicium, in which, as we shall see, he has also arrived at the knowledge of still more decisive facts than those observed by our illustrious *confrere*, M. Wöhler, as regards the preparation of crystallised silicium.

Comptes Rendus, No. 2, January 14th, 1856.

On CRYSTALLISED SILICIUM and CHARCOAL—GENERAL METHOD for the PRODUCTION of some FIXED SIMPLE BODIES by means of their VOLATILE COMBINATIONS.

By M. H. SAINT-CLAIRE DEVILLE.

I HAD the honor, in the course of last year, to show to the Academy, some silicium, crystallised in pyramids, with six curved faces, and whose forms very much resemble those of the diamond. The chemical analysis which have ranked borax and silicium by the side of charcoal, led me to think that silicium might have its diamond as it has its graphite; the crystallographic analogy, on which we base, in our science, the most unquestionable approximations, would thus completely give reason to the most generally adopted classification of the metalloids. But the measurement of crystals with curved faces being impossible, I was at that time compelled to postpone the definitive solution of this problem of general chemistry.

New experiments now enable me to submit to the examination of the Academy, complete crystals of silicium, defined by precise measurement. These crystals, in long needles of 6 or 7 millimetres in length, are sometimes hexagonal crystals, surmounted by a very acute pyramid, with curved and unmeasurable faces, sometimes rhombohedra threaded like beads, according to their axes of figure, and of which the angles to the culminating edges are about $69^{\circ} 30'$ with an uncertainty of $25'$ to $30'$. These observations, which I owe to the kindness of M. de Senarmont, were made with crystals so minute that I should never have thought of putting them on the goniometer. Afterwards, having obtained some rhombohedra rather larger, I was able to measure an

angle of $69^{\circ} 10'$, and even its supplement, which indicates that the rhombohedra has a tendency to be completed in each of the grains constituting the string of beads which I have mentioned.

The rhombohedral silicium resembles, in its color, the oligist iron of the island of Elba with all its iridescence; it scratches glass easily, and its needles are sufficiently strong to pierce the epidermis of the fingers, when they are taken hold of by their points.

These crystals are of absolute purity, as I have proved by several analyses, which gave me always the same result; they fuse at a temperature intermediate between the fusing points of gold and cast-iron, and then they take, with the greatest ease, the form analogous to the diamond with curved faces, which appears peculiar to the silicium obtained by fusion. Is this form identical with the rhombohedra which I have just described, or is it different from it? The physical properties will enable me to demonstrate this, when I have at my disposal sufficient silicium to be able to determine them with accuracy, for fused silicium has no cleavage.

In order to prepare rhombohedral silicium, I introduced aluminium placed in a boat, in a porcelain tube, traversed by a current of hydrogen, saturated with vapors of chloride of silicium. The latter is placed in a tubulated flask, which is gently heated by being cautiously brought near to a piece of incandescent charcoal. The tube is heated to a bright cherry-red, and the operation is continued, until, on looking into the apparatus by the open end of the adapter which terminates it, no more thick vapors of chloride of aluminium are perceived. The needles of silicium are removed from the boats, and are purified from the impurities which may adhere to them, by treating them successively with aqua regia, boiling fluoric acid, and fused bisulphate of soda. We find, also, when the operation is not complete, small globules of siliciuret of aluminium, in which there is from 40 to 50 per cent. of silicium, which corresponds to the combination Si Al^2 .

The following is what occurs in this operation:—the chloride of silicium is decomposed by the aluminium, which seizes the displaced silicium; whence results a true solution. Each molecule of chloride which comes over operates its concentration, and when the saturation of the metallic bath is complete, the silicium, being lighter, crystallises on the surface, as camphor would do on the surface of an alcoholic solution.

It will be understood, that such a process is susceptible, with modifications, of being applied to the preparation of all the fixed simple bodies, capable of forming volatile combinations, decomposable by a matter capable of dissolving them; we may then obtain them crystallised.

Thus, boron is soluble in aluminium, and may be prepared in the same manner as silicium. But I can yet say nothing about this substance, which is obtained pure only with unheard of difficulties. I have not yet analysed the small crystals thus obtained by means of chloride of boron.

Charcoal does not combine with aluminium; thus, when chloride

of carbon* is decomposed by means of this metal, we simply obtain lamp-black. The chloride of carbon is likewise decomposed by sodium, and we obtain only amorphous charcoal, even when the crude product of the reaction has been properly calcined. This is because the sodium no longer dissolves the charcoal.

But if we treat iron (and better, cast-iron), which has the property of dissolving charcoal, by the same chloride of carbon, we obtain a crystallised substance, very different in its properties from the graphite of cast-iron, which is produced in quite different circumstances.

Crystallised charcoal is in small plates, ordinarily irregular, but many are evidently hexagonal; their lustre is completely metallic. Many of them present striæ, or rather parallel furrows, which proceed right and left from a rectilinear *nervum*, like the feathers of a hen, and this arrangement generally announces a grouping of crystals. It is known that native graphite is likewise hexagonal.

I made analogous experiments with titanium and zirconium, which I shall shortly have the honor of submitting to the Academy. The difficulty of producing zirconium perfectly free from titanium and aluminium, and the fear of describing its properties from impure samples, alone prevent me from speaking of them now.

When we substitute, in the preparation of rhombohedral silicium, fluoride of silicium for the chloride, we obtain, at the same time as the silicium, a matter crystallised in cubes, the angle of which was measured, and which exerted no action on polarised light, transparent and powerfully refringent. Crystals of this matter, applied in the form of a geode, to intact pieces of aluminium, resemble and might be mistaken for fluate of lime. These crystals are unattackable by fluoric acid, nitro-fluoric acid, which seems to free them from the adherent silicium, and by sulphuric acid, even boiling, which disengages only traces of fluoric acid; finally, they volatilise only at a bright red heat. This new substance is fluoride of aluminium, perfectly free from silicium, as I proved by many analyses, made by several different methods. It contains 33·3 per cent. of aluminium, and theory indicates 33·2 for fluoride of aluminium, $Al^2 Fl^3$.

All these properties are contrary to those which one might have presumed from analogy. Moreover, it may be directly prepared by a process which, it appears to me, must make the analogy of hydrochloric acid with fluoric acid, appear less certain; it is sufficient, indeed, to pour on calcined alumina, an excess of pure fluoric acid, to dry the mixture, and to introduce it into a tube of charcoal† or platinum, which is traversed by a current of hydrogen, and which is heated to white red, to see the fluoride of aluminium sublime, which is deposited in the form of crystals, or cubic bars of several centimetres in length,

* I obtain chloride of carbon by the action of dry chlorine on the vapor of sulphuret of carbon, at a red heat, and potassa on the condensed product, in order to separate the chloride of sulphur.

† A description of these new vessels will be found in an early No. of the *Annales de Chimie et de Physique*.

on the cold sides of the tube. Thus, the fluoride of aluminium is one of the most beautiful crystallised matters of chemistry, and, perhaps, the most unattackable by most reagents.

M. DE SENARMONT added a few words to the details given by M. Dumas concerning the various products presented by M. Deville.

A long time ago, he had examined the crystalline alloys, with a lamellar fracture, of aluminium, more or less saturated with silicium, prepared by fusion, and for a fortnight he had been acquainted with the pure and clearly defined products now presented by M. Deville to the Academy. He had even measured the first crystals of silicium, obtained by the reaction on aluminium, both from the chloride and the fluoride of silicium. M. Deville had been kind enough to keep them for him, although he was quite as well able as himself to determine their form.

These crystals, in very delicate needles from 6 to 7 millimetres long, were sometimes in regular hexagonal prisms, surmounted by a very acute pyramid, with curved faces, agreeing insensibly with the faces of the prism, and not measurable; sometimes small and very acute rhombohedra threaded like beads, according to their axes of figure and in a parallel situation.

The prisms were striated perpendicularly to their length, so that the flame of a candle, seen by reflection, was accompanied laterally by spectra of diffraction, which, however, in no way impaired the accuracy of the measurement.

As to the rhombohedra, their angles to the culminating edges were about $69^{\circ} 30'$, with an uncertainty of $25'$ to $30'$. Although, indeed, the faces were highly reflecting, as they were faintly striated parallel to the culminating edges, a spectra of diffraction elongated in the vertical direction of the reflected images, and opposed the absolute accuracy of the coincidences.

Comptes Rendus, No. 2, January 14, 1856.

INDUSTRIAL CHEMISTRY.

On the PRESENCE of LIME in SILK, and on its INCONVENIENCES in the OPERATION of SEWING.

By M. GUINON.

It has been remarked for some years past that silk stuffs of bright or medium colors, but especially taffetas, very soon after their manufacture exhibit a great number of dark spots or stains. These spots, which are at first very small, and scarcely visible, are increased and spread in the cylindering, and diminish the value of the stuff, even when the stains have been removed with essence of turpentine, or by other solvents of the fatty bodies.

These defects, which occur very frequently, might seriously damage the reputation of the Lyonese manufacture. It was, therefore, very desirable to ascertain the cause, and to find the means of preventing

them. I have arrived at this means by processes which it is not my intention to describe here. I shall merely detail some experiments, the results of which will, perhaps, put us in the way of knowing the cause.

I have observed, that, after the scouring of silk, even when it has been performed with an experimental object, with distilled water, and perfectly tested soap, there always remained a deposit of calcareous soap. This observation led me to suspect that the silk might contain naturally a certain quantity of lime which is partially removed from it during the scouring. To arrive at the direct demonstration of this fact, I devoted myself to a series of analytical experiments which have confirmed my opinion. To the results of the analysis I can add a perfectly convincing counter-proof. I have proved that silks previously treated with dilute hydrochloric acid, require for scouring only a much smaller quantity of soap than they would have required without that previous treatment. My experiments, undertaken in 1854, were made on silks of various qualities, and from various sources. I submitted to it spun raw silk, with care, *à la condition* of Lyons, on account of the Société d'Agriculture; the results were the same. I proved the presence of the calcareous substance in the liquids used in the scouring; and I had ascertained that the water employed contained none.

From this period, the existence of lime in the very substance of the silk was unquestionable. It was only necessary to determine its proportions and its state.

The following are the details which my analysis furnished on the first point:—

	grammes.
Yellow wool of the country . . .	0·49 per kilogr.
White raw wool of the country . . .	0·44 „
China silk	0·30 „
Another specimen	0·48 „
Yellow Bengal silk	0·42 „
Tussah silk	0·79 „

These results were obtained by means of hydrochloric acid, very much diluted with water. In the same conditions, acetic acid would furnish the same results.

The proportions of calcareous matter indicated in the above table are considerable. They will appear especially so when we reflect that the lime in it represents about one-third of the alkaline base which enters into the composition of the soap employed, that is to say, on the average, 25 per cent.

The existence of the calcareous matter in silk being ascertained, the next question was, in what state does it exist in it? We know that it is not in the state of phosphate, since it is soluble in acetic acid, and because the solution, evaporated and calcined, leaves as a residue, quick lime. I am inclined to think that it exists in it as a constituent principle which is formed at the moment of the organisation of the serigen substance.

From the experiments and observations which I have just mentioned, it evidently follows that a decomposition of soap is effected under the influence of heat at the time of scouring; that a calcareous salt is formed, and is fixed or interposed unequally between the strands of silk, and produces stains when the stuff, and consequently the calcareous soap adhering to it, are subjected to the action of heat and pressure in the cylindering, and sometimes afterwards by spontaneous decomposition.

Comptes Rendus, No. 5, Feb. 4, 1856.

AGRICULTURAL CHEMISTRY.

EXPERIMENTAL RESEARCHES on NITRIFICATION and on the SOURCE of the NITROGEN in PLANTS. By M. S. CLOEZ.*

THE question of the assimilation of nitrogen by vegetables is now greatly attracting the attention of physiologists, agriculturists, and chemists. Have plants the property of directly absorbing the nitrogen in the state of simple gas, as it exists in the atmosphere? Or, can they assimilate this element only when it is in the form of a binary combination, as ammonia and nitric acid? Or, finally, do they derive their nitrogen at once from both these sources? These are the questions, which one might put to oneself *a priori*, but which have not yet been completely solved by experiment, notwithstanding the numerous and interesting works which have been published for some time past on this subject.

The property possessed by plants exposed to the light of disengaging oxygen by the decomposition of water and carbonic acid—of acting in some measure like reducing bodies—has led me to think, for some time past, that the nitrogen of these plants must arise principally from the nitrates which exist, or which may be formed in the soil in which they grow.

While following M. Ville's experiments, repeated last year at the Museum of Natural History, under the inspection of a committee of the Academy of Sciences (*See THE CHEMIST*, for Dec. 1855, and for Jan. and Feb. 1856), I was led, in consequence of the part which I was disposed to attribute to the nitrates in the act of vegetation, to raise the question of the possibility of the formation of these salts, in the circumstances necessary for making the experiments. We find here, indeed, united, almost all the conditions which can favor the production of nitric acid, by the direct combination of the nitrogen and oxygen of the air; the earthen pots destined for containing the soil perform, with the pieces of brick which cover the bottom of them, the part of porous cells, moisture is always abundant, and we find an alkaline substance in the ashes added to the soil; the organic matter alone is wanting, or exists in very small quantity.

* This paper has been transmitted to the committee, charged with the consideration of M. G. Ville's work.

I cannot invoke, for solving the question raised, the theory of nitrification proposed by Longchamps, thirty years ago; this theory does not rest on any precise experiment, and no one now would admit it in the sense in which it was enunciated by its author. This is especially owing to the fact that, at the period at which it was proposed, we were not acquainted with the property possessed by spongy platinum, and several other porous or finely divided bodies, of condensing gases, and of effecting their combination in certain cases.

I therefore had at once to seek by careful experiments, the solution of the problem, which I had set myself at starting, namely: the possibility of the formation of nitric acid, by the direct combination of the nitrogen and oxygen of the air, under the influence of a porous matter, alkaline or calcareous, and with a total absence of every nitrogenous or ammoniacal substance. The question, viewed in its generality, required various, numerous, and long continued experiments; I have at present made only a few, but I have already obtained satisfactory and very clear results, which completely confirm my anticipations. These are the results which I have now the honor of submitting to the Academy; they are still incomplete, but I think that they are sufficiently important to merit the attention of chemists and agriculturists. The interest of the question, moreover, is not confined to vegetable physiology and agriculture; it should also be taken into consideration with relation to the production of nitrate of potassa, for the manufacture of gunpowder.

I operated by passing a current of air, freed from acid and ammoniacal vapors, through a series of flasks filled with fragments of a porous substance, impregnated with an alkaline or earthy carbonate.

Before reaching the flask, the air is purified by travelling, slowly and bubble by bubble, through long glass tubes of peculiar form, having the advantages of Gay-Lussac's U washing tubes, without their inconveniences. One of these tubes contained a solution of alkaline carbonate for the purpose of retaining the acid vapors; in another, there was dilute sulphuric acid for absorbing the ammonia; the current afterwards traversed a long column of pumice in large pieces impregnated with pure sulphuric acid; it then passed into the flasks in which the reaction had to be made.

The first flask contained fragments of new brick, previously calcined and then impregnated with a solution of 100 grammes of pure carbonate of potassa.

The second flask contained, like the first, pieces of alkalisied brick, enveloped with carbonate of lime, obtained by precipitation.

In the third flask, there were the same substances as in the second, except that carbonate of magnesia was substituted for carbonate of lime.

The fourth contained similar fragments of brick, enveloped with precipitated carbonate of lime; it differed from the second by the absence of alkaline carbonate.

The next four flasks contained, instead of brick, fragments of pumice, first calcined with sulphuric acid, afterwards washed with distilled water, then again heated to redness, without the addition of

acid. Each of these flasks contain besides, like the first four, and in the same order, alkaline and earthy carbonates, alone or mixed.

The ninth flask was filled with broken porous bones, calcined at a white heat and impregnated with a solution of 100 grammes of pure carbonate of potassa.

The tenth flask contained calcareous marl, extracted from a quarry near Belleville.

Starting from this flask, the current of air again traversed a column of pumice impregnated with sulphuric acid, then it passed successively into four flasks filled with uncalcined pumice, mixed with the same matters as had been added to the brick and calcined pumice of the first flask.

The fifteenth flask was filled with chalk from Bongival, slightly moistened.

The sixteenth contained calcareous marl with alkaline carbonate.

The seventeenth contained an intimate mixture, under the form of bullets, of decanted caolin and precipitated carbonate of lime.

The eighteenth was filled with argillaceous earth, taken near Villejuif, at the depth of one metre.

In the nineteenth flask, there was coke in fragments impregnated with a dilute solution of carbonate of potassa.

Finally, the twentieth and last flask contained bakers' cinders, with alkaline carbonate.

The experiment was commenced on the 15th of September 1854, and concluded towards the end of the following April, at which time saline efflorescences appeared in some of the flasks; its duration would have been about six months, if the current had not been forcibly interrupted during the severe cold of winter. This circumstance prevented the estimation of the volume of gaseous fluid which passed into the apparatus.

After the experiment, nitrates were found in considerable quantity in the flasks containing the brick, calcined pumice and ordinary pumice. The Bongival chalk, the pure calcareous marl, and the marl containing alkaline carbonate, and the mixture of kaolin and carbonate of lime, furnished traces of the same salts; none were found in the calcined bones, or in the argillaceous earth. An accident which had occurred in the course of the experiment prevented me from ascertaining what had taken place in the flasks containing the alkalized coke and wood charcoal.

It results from this work, that a current of air freed from acid and ammoniacal vapors, in passing through porous matters, may give rise, in certain cases, to the formation of nitric acid and nitrates.

It remains to be seen, what would occur if these same porous matters, which are so easily nitrified in a current of air, were in contact with a limited volume of air not renewed; at the recommendation of M. Chevreul, I have carried on for four months experiments which realise these conditions, the results of which I hope shortly to communicate to the Academy.

It has yet to be ascertained what influence the electrified or ozonised

oxygen, which may be found in the air, would exert in the phenomenon of nitrification; this is a subject with which I have also been occupied for a long time, but concerning which I can at present only give conjectures.

Comptes Rendus, No. 22, Nov. 26th, 1855.

RESEARCHES CONCERNING *the* ASSIMILATION *of the* NITROGEN *of*
the AIR by VEGETABLES.

By MR. HARTING.

HAVING, in concert with Mr. J. W. Gunning, made a series of researches on the subject, which occupies the attention of M. Ville, the results of which I communicated to the Académie Royale des Pays-Bas, at its sitting of October 28, 1854, I beg permission of the Academy to present to it some reflections which may help to determine the question.

I added to this letter two copies of the Memoir published by Mr. Gunning and myself, as well as of one by M. Mulder; the latter going to prove that the nitrogen of the air may contribute indirectly to the nutrition of plants by its absorption into vegetable earth, in which it is converted into ammoniacal salts and nitrates, but that the nitrogen of the air in the gaseous form never enters into plants to be assimilated in them. At the end of this Memoir are some considerations written by me to show that, notwithstanding the negative results obtained by M. Boussingault, as well as by ourselves, the arguments of M. Mulder are not so convincing as to lead us to regard the question as fully solved, and as requiring no further researches. After the very interesting report which M. Chevreul has just read to the Academy (for which see THE CHEMIST for Dec. 1855, and Jan. and Feb. 1856), one might, at first sight, be led to suppose science to be satisfied; however, I persist in thinking that she has not yet said her last word, and that the question itself should be investigated from the very bottom.

At the commencement of the experiment, none of the matters with which M. Ville composed his artificial soil contained organic substances capable of being converted into humic and ulmic acids, and of furnishing at the same time the hydrogen necessary for the formation of ammoniacal salts. But it is easy to show that this state of things could not have lasted long, and that the quantity of vegetable matters in process of humification must necessarily always go on increasing during the later period of the vegetation.

First the teguments of the seeds, and then the cotyledons, and the few leaves which, in perishing and falling in the surface of the moistened soil, underwent this alteration. But there exists another much more prolific source of humifiable matter, and which does not fail so long as the vegetation lasts. I allude to the organic matters which the roots contribute to the soil. I do not mean to adduce the superannuated theory of a radicular excretion, in the ordinary sense of the word, but

I speak of a fact well known to all who have studied the anatomy of roots, and who have made investigations concerning their histiogenesis. This fact is the excoriation which the extremities of the radicles continually undergo during their growth, that is to say, during their passage through the interstices of the soil, so that the latter contains remains of a cellular tissue wherever the radicular fibres have penetrated. This may easily be proved by the microscopical examination of such a soil. I have treated this subject more fully in the *Monograph on the Marattiaceæ*, published by M. de Vries and myself, page 41. This excoriation, occurring ordinarily by the detachment of shreds of irregular form and varying extent, in some rare cases still retaining the form of a small hood covering the radicular extremity, resembles the continual detachment and renewal of the epithelia of animals. The cellules of which these shreds are composed have, consequently, only an ephemeral existence. Their sides are very thin, and frequently those which are formed at the extremity of the layer, while it still adheres to the radicular fibre, already undergo a commencement of humification, recognisable by their having assumed more or less of a brownish tint. This humification makes still greater progress after they have become detached. Since the subjacent layers enveloping the extremity of the fibre, which is the sole seat of the reproduction of the cellules, continue unceasingly to produce new ones which are detached in their turn, so long as the increase in length continues, the quantity of these remains of a cellular tissue, easily convertible into humic matters, always goes on increasing.

There are two points in the Report of the Committee which seem to indicate that the quantity of ammonia produced by the humification may have been very considerable. In the first place, the excessive development of the roots of pot No. 1, which made their way even into the water, through the holes in the pot. Then the very remarkable circumstance that the water contained in the glass case, contained more ammonia after than before the vegetation of the plants. This increase of ammonia in the water into which the roots penetrated, at the same time that the nitrogen in the plants underwent a very considerable augmentation, could scarcely be explained in any other manner, than that which I have pointed out.

In the experiments made by Mr. Gunning and myself, we endeavored to render this formation of ammonia in the apparatus itself impossible. Our experiments were made according to both methods, that is to say, in limited spaces of air, and in a current of air freed from ammonia. The apparatus which we employed were in general similar to those of M. Boussingault and M. Ville. However, we found it advisable to introduce some more or less considerable modifications. I will confine myself to mentioning here that which had for its object the exclusion of all access of air to the soil in which the plants grew, as well as from the water with which it was moistened. We attained this object by using glass vessels, instead of porous pots provided with holes, and by covering the surface of the artificial soil contained in them, with a layer of about 1 centimetre in thickness, and consisting of a mixture

of wax and olive oil melted together. This layer was applied when the germination was sufficiently advanced for the stems to reach about two centimetres above the surface. In order to prevent the immediate contact of the stems with the mass still fluid at the temperature of 60° C. (140° F.), they were previously protected with small tubes of vulcanised caoutchouc, cut longitudinally, and applied as exactly as possible to their surface without restricting their further increase in diameter. The water which the plants caused the soil to lose by transpiration, could be renewed proportionately by means of a glass tube, one of the ends of which opened into the soil at the depth of a few centimetres, whilst the other, widened into the form of a funnel, was outside the apparatus. A stop-cock, with which this portion of the tube was fitted, enabled us to regulate the quantity of water added, and prevent, at the same time, the external air from entering into the apparatus.

The results obtained by us may be summed up in a few words. Our plants (*Vicia faba*, *Polygonus fagopyrum* and *Avena sativa*) were very healthy during the first period of vegetation. They put forth several leaves, and several of the *Vicia faba* had stems 45 to 50 centimetres in length, and 4 to 5 millimetres in thickness. Two of these plants showed a commencement of flowering. But the leaves very soon began to grow yellow, the plants acquired an unhealthy appearance, and the experiment was interrupted several times in order to remove those plants which ceased to grow, and whose decomposition might have become a source of error. This removal was effected the more easily, as, instead of a single glass case very difficult to keep closed in all its parts, we employed a series (4 to 7) of smaller apparatus, consisting of well varnished and dried tinned iron boxes, surmounted with bell-glasses of the capacity of 18 litres. In order to give access to the tubes, each box was perforated in four places, two apertures serving for connecting the various parts of the apparatus, another for giving access to the tube by which to add the water, and the fourth for introducing the carbonic acid, the quantity of which was regulated by means of an apparatus similar to that of Döbereiner for the development of hydrogen.

The comparison of the weight of the plants collected and dried, with the weight of the seeds, gave us the unexpected result that in no case did the weight of the former exceed that of the latter. An accurate determination of the nitrogen was consequently quite superfluous. It was evident that our plants had ceased to grow as soon as the nutritive substances of the seeds were exhausted.

These researches led, consequently, to no decisive result, for we could not regard a negative result as such. It is possible that plants cannot grow in the condition in which we had placed them, that is to say, in a soil containing neither ammoniacal salts nor nitrates, and to which the access of air is entirely interdicted. But it may be also that, independently of those causes, others, inherent to the method employed, may have exerted an injurious influence by rendering the plants unhealthy, which otherwise might have been able to continue to live,

and perhaps to absorb the nitrogen gas by their surface exposed to the air. For this negative result to be adopted, in fine, the experiments must yet be varied and modified in various ways. I hope to contribute my part to this investigation when the proper season arrives.

As regards the present state of the question, it may be summed up in the following manner:—

1.—Plants absorb ammoniacal salts, and the nitrates which exist in the soil, by means of their roots.

2.—The nitrogen of the air contributes to the formation of these salts in the ground, and, consequently, *indirectly* to the nutrition of the plants.

3.—Nothing has at present proved that the nitrogen of the air contributes directly to their nutrition

Comptes Rendus, No. 22, Nov. 26th, 1855.

On a NEW MEANS of ESTIMATING the NITROGEN of the NITRATES, followed by some EXPERIMENTS, proving that NITRATE of POTASSA is DECOMPOSED by PLANTS, and that, for an equal quantity of NITROGEN, NITRATE of POTASSA acts better than SAL AMMONIAC.

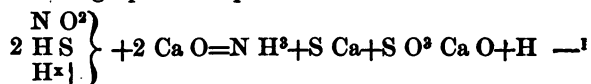
By M. G. VILLE.*

My object at the present moment not being to write a memoir, but simply to take date for some new facts which I think important, I reserve until the time when these studies shall be published in a complete form, the task of presenting the state of science on the questions of which I treat, and that of making known the extent of the assistance which I have derived from the men of science who have gone before me in the path on which I have entered.

First Part.—*Estimate of the nitrogen of the nitrates.*

This new process is founded on the property which binoxide of nitrogen possesses of being changed into ammonia when it is passed at a temperature approaching dull red, into a tube filled with soda-lime, mixed with an excess of hydrogen and sulphuretted hydrogen. In these conditions, the binoxide of nitrogen is converted into ammonia, and the reaction is so clear, so complete, that it may be used with the greatest advantage for estimating the nitrogen of the nitrates. For that purpose it suffices to pass the mixture of hydrogen and ammonia into a tube with a bulb containing metrical sulphuric acid. The estimation of the nitrates thus ranks among the very advantageous processes of the volumetrical method.

The following equation expresses the reaction:—



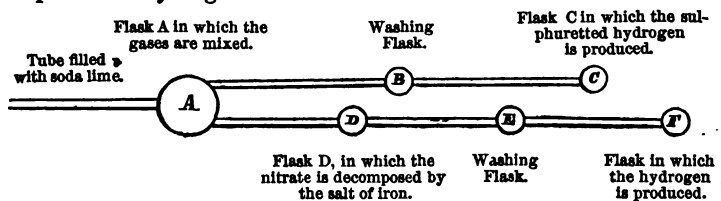
* This note was deposited under seal at the Sitting of the Academy of August 13, 1855, and opened, at the Author's request, on Nov. 26, 1855.

The following experiment may give an idea of the merit of the process as regards precision:*

	Nitrate employed. gr.	Nitrogen obtained. gr.	Nitrogen employed gr.		Difference.
1.	0.251	0.0347	0.0347	—	0.0000
2.	0.147	0.0210	0.0203	—	0.0007
3.	0.067	0.0090	0.0092	+	0.0002
4.	0.201	0.0278	0.0279	+	0.0001
5.	0.244	0.0338	0.0345	+	0.0007

To convert the nitric acid of the nitrate of potassa into binoxide of nitrogen, I use a solution of protochloride of iron, into which it is poured, and it is then boiled.

The mode of operating is, moreover, very simple. The following are the details:—We take a small flask of 200 cubic centimetres' capacity, furnished with a cork which bears two tubes; this flask is half filled with a solution of protochloride of iron, which should contain an excess of acid, and then the solution of the nitrate is added. This flask communicates, by one of the tubes, with a flask A, in which hydrogen is produced; and, by the other tube, with a flask A, which communicates with the tube of soda-lime, and in which the mixture of binoxide of nitrogen and hydrogen should be mixed with the sulphuretted hydrogen, which arrives from a special apparatus before entering into the tube. In the flask, the tubes which convey the gases, should dip into mercury, in order that we may be able to account for the quantities of hydrogen (mixed with the binoxide of nitrogen) and of sulphuretted hydrogen which come in each from its side.



The apparatus being mounted, a current of hydrogen is passed in for eight or ten minutes, in order to expel the air, and then the tube containing the soda-lime is heated, and a few bubbles of sulphuretted hydrogen are passed in. At this moment, we heat the flask D, which contains the solution of iron, and it is quickly made to boil. During the whole time the boiling lasts, a current of hydrogen should be passed into the flask. The production of this gas is regulated in such a manner that there arrives into the flask A, three or four times more of sulphuretted hydrogen. The reaction is completed after ten

* I wrote to M. de Senarmont, on the 27th or 28th of July, to communicate this process to him. Since that time I have made known to MM. Chevreul, Regnault, and Payen, the principle of the process.

minutes' boiling. In order to detain in the flask A all the water which distils, a few pieces of chloride of calcium are placed in it.

If we wish to have another indication besides the duration of the ebullition, it will be sufficient to add to the liquid of the flask B, about 20 grammes of mercury. As soon as the liquid enters into ebullition, the solution of iron, which was green, becomes brown; but, by a secondary reaction, the mercury reduces the perchloride of iron which has been formed, and the liquor again becomes green.

Second Part.—*Decomposition of Nitrate of Potassa by Plants.—Assimilation of its Nitrogen.*

On the 20th of last March, I prepared eight pots with:—

Calcined brick	578,000
Calcined white sand	900,000
Sulphate of lime	6,086
Minobasic phosphate of lime	0,309
Crystallised phosphate of magnesia	0,698
Phosphate of potassa	0,677
Chloride of sodium	0,011
Silicate of potassa	2,000
Silicate of soda	0,250
Concentrated solution of hydrate of iron	0,271

These eight pots were divided into four series of two each, the pots of each series being distinguished by the letters A, A¹, B, B¹, C, C¹, D, D¹, E, E¹.

In the pots A, A¹, nothing was added to the mixtures indicated above.

In the pots B, B¹, 4·015 grs. of lupin seeds were added, which contained 0·238 grs. of nitrogen.

In the pots C, C¹, 1½ grs. of nitrate of potassa was added, containing also 0·238 gr. of nitrogen.

In the pots D, D¹, 0·908 gr. of nitrate of sal-ammoniac was added, containing 0·238 gr. of nitrogen.

Finally, in the pots E, E¹, 0·68 gr. of nitrate of ammonia was added, also containing 0·238 of nitrogen.

On the 20th of March, twenty seeds of a large white *Jaulard* wheat were sown in each pot. From the commencement of the experiment, the pots which contained the nitrate of potassa had a marked advantage over all the others. Between the pots in which there was only sand and those in which there was nitrate of potassa, comparison was impossible. At this time (August 14) the wheat is in ear, and the pots C, C¹, which contain the nitrate of potassa, present a much finer vegetation than all the others, which have, more or less, received the same quantity of nitrogen.

As soon as this result became evident, I felt that there was an important phenomenon to be elucidated. Without waiting for the end of the experiment, which had lasted for several months, and which, at this very time (August 14) is not finished, I instituted the following new experiment, with the view of ascertaining sooner whether the

nitrate of potassa was decomposed, and whether its nitrogen was assimilated by the plant.

On the 25th of June, I put into a small pot,—

Fragments of calcined brick	400 grs.
Calcined sand	600
Cress ashes	3

In this pot, I sowed 60 seeds of cress, containing 0.004 gr. of nitrogen, and spread on the surface of the sand, 0.2 gr. of nitrate of potassa. This pot, therefore, received of nitrogen,—

In the sand	0.004 gr.
In the nitrate	0.027

0.031

The seeds germinated well; the vegetation followed its ordinary course, and the plants were very fine. I gathered the crop on the 20th of July. The crop weighed, when green, 10 grammes, dried and burned with soda-lime, it gave 0.028 gr. of nitrogen.

The sand of the pot was washed with the greatest care; the liquid, concentrated and tested, gave only a slight indication of nitrate.

Owing to this result, I conclude from this experiment that the nitrate of potassa was decomposed by the plant, and that the nitrogen of this nitrate, changing its state, has entered into the intimate composition of the tissue of the plant.

Since that time I have instituted several series of experiments, with the view of investigating this decomposition, and in all the experiments in which the plants received nitrate of potassa and sal-ammoniac, the vegetation always prospered better with the nitrate of potassa, although, in both cases, there was the same quantity of nitrogen. I have, at this moment, six pots of colza, sowed on the 13th of July; in the pots which contain nitrate of potassa, the plants are larger and more beautiful than in those which have received sal-ammoniac. All these vegetations, wheat, cress, and colza, are carried on in France.

Some persons, holding as true the results of my first experiments, think that nitrogen, of which I have always proved the fixation by plants, comes from the nitrate which would be formed in the sand used for the vegetation. According to this opinion, the oxidation of the nitrogen of the air would be the necessary condition of the assimilation by plants.

Without wishing, for the moment, to explain the above, I must own, notwithstanding all the trials I have made in order to elucidate it, that this interpretation of the phenomenon has not been favorable to it.

I shall at once commence a new series of experiments for deciding this point. I shall submit this result before saying any more; but, I repeat, that which I have done all this year is not favorable to the idea that nitre would be formed, and that this nitre would be the source of the nitrogen whose fixation is effected when we cultivate plants in suitably prepared soil of sand.

Comptes Rendus, No. 22, Nov. 26, 1855.

On the PREPARATION of SEEDS with ARSENIC.

By M. BOUSSINGAULT.

Opportunity of employing, in certain circumstances, arsenic in the preparation of seeds.

THE havock occasioned, in 1854, in Alsace, by field-mice, will be well remembered: in the arrondissement of Wissemburg the losses were estimated at more than 800,000 francs (about £32,000). The tillage destroyed a prodigious number of these animals; nevertheless, in the autumn, the lands turned up by the plough, containing such a number as to cause serious uneasiness at seeding time, I was consulted as to whether it would do to destroy them by means of poison. The utility of poisoning the field-mice, in order to preserve the seed, appeared to me to be certain, inasmuch as the corn would not acquire poisonous properties, by the mode of preparation most generally used in the country. The substances used for preparing seeds are lime, which gives its name to the operation,* wood ashes, the *purin* of dung pits, common salt, alum, sulphate of soda, sulphate of copper, verdigris, arsenious acid (commonly called arsenic), and the sulphurets of arsenic. Each of these substances fulfils the object proposed in liming, that of protecting the crop from caries; as regards the mode of application, it naturally depends on the properties of the matters employed. Thus, such of these matters as are very sparingly soluble, are diffused in powder over the corn, the surface of which is suitably moistened. The seeds are made to imbibe those which are very soluble in water. Very frequently they are associated with matters proper for liming. According to Marshall, the Norfolk farmers moisten the seed with a solution of common salt, before sprinkling it with lime; this is the process extolled by Matthieu de Dombasles, with this simple difference that sulphate of soda is substituted for chloride of sodium.

With the exception of sulphate of iron, all the agents used for liming are poisonous. Even lime has a certain poisonous action, but it must not be forgotten that it very rapidly loses its causticity, owing to its combining with the carbonic acid of the atmosphere, forming the inert carbonate of lime, with which the seed remains covered.

Notwithstanding all the efforts hitherto made for prohibiting the use of arsenic in this way, agriculturists in some parts have persisted in using it, despite the restrictions placed on the sale of this poison. Since our agriculture in the East has suffered so much from the damage caused by field-mice, I own that I am better able to understand this persistence. In fine, liming should have two objects, to preserve the crop from caries and from the voracity of vermin; and if seed treated with common salt, sulphate of soda, or lime, is properly prepared for preventing the development of parasitic cryptogamia, it is certainly thereby protected from being attacked from rats, mice, or field-mice.

* We have thought it better to employ the word "preparation" instead of "liming," which would be the literal translation of *chaulage*. It appears absurd to say "liming with arsenic." J. W.

There is rather reason to believe that it is so seasoned as to excite their appetite.

Preparation by means of sulphate of copper, which was recommended, in 1807, by M. Prevost, as one of the most powerful preservatives against decay, would seem capable of satisfying all exigencies; for, whilst this salt is poisonous, although in a less degree than arsenic, it presents less danger in its employment, on account of its color and the strong taste of its solution. Preparation by means of this salt increases annually; it has long been practiced in Alsace, so that, in order to be able to answer the question put, it was necessary simply to prove whether corn treated by a salt of copper poisoned field-mice,

I may here describe the mode of preparing with sulphate of copper. J. Saint Clair prescribes 100 grammes (about 3 oz.) of sulphate dissolved in 11 quarts of water to 1 hectolitre of seed. The corn is placed in a tub with the solution, to which is added sufficient water for it to be covered with a layer of 12 to 16 centimetres in thickness. It is stirred, and after having removed the seeds which float, it is set to drain in baskets after an hour's steeping. The baskets are afterwards steeped for a minute in fresh water; then after having drained the seed a second time, it is dried by spreading it on the floor.

Experiment 1.—Wheat prepared for sowing with sulphate of copper, in conformity with the directions above indicated, was given in unlimited quantity to mice and to field-mice, who ate it for several days without experiencing the least inconvenience. This corn then did not possess poisonous properties, and, so far from aiding in the destruction of vermin, it served them as food. The harmlessness of the seed was owing, doubtless, to the smallness of the dose of the cupreous salt introduced.

Experiment 2.—It occurred to me to increase the proportion of the sulphate, so that, for the accuracy of the result, the proportion assigned, 125 grammes per hectolitre of seed, might be completely absorbed.

In order to insure the penetration of the entire quantity of the sulphate which we wish to introduce, it was necessary first to ascertain how much water a given volume of seed would absorb; it was moreover useful to know the result of this determination, for all the cases in which it was desired to prepare seed with a soluble substance.

One decilitre of corn, weighing 70 grammes, was put into a glass vessel with 64 cubic centimetres of water; one hour after, the wheat was thrown on a cullender:—

Water flowed out		46 c.c.
		64
		—

Difference, or water left in the corn		18
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The water and the corn were reunited one hour after, it was again placed on the cullender:—

Water flowed out		48 c.c.
Before we had water		46
		—

Difference, or water absorbed		2
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It is evident that it is especially during the first hour of immersion that the water is fixed in the corn; 1 litre of seed takes therefore in one hour, either by absorbing or by being moistened, 160 cubic centimetres of this liquid. When the steeping must not last more than an hour, it is convenient to employ not more than 16 litres (quarts) of water to each hectolitre of seed to be prepared, when it is desired that no liquid should remain after the immersion, as would be the case if we wished to make the whole of the dissolved substance penetrate into the seed.

Accordingly, in order to prepare the corn, in the ratio of 125 grammes of sulphate of copper per hectolitre, 1.25 gr. of salt was dissolved in 160 cubic centimetres of water; then the solution was poured on a litre of corn; when the liquid was absorbed, the seed was dried in the air; its episperm had an extremely faint greenish tint. When deposited on damp sand, this corn germinated as rapidly as if it had not been treated with this sulphate.

Some of this corn was given to a mouse placed under a large bell-glass, having two lateral tubulures and a tubulure at the upper part, so as to allow of the air being renewed. The bell-glass was placed on a porcelain plate, on which blotting paper was laid, to serve as litter. Very watery roots were supplied for the purpose of quenching thirst. The mouse ate corn thus prepared for three days, without any ill effects, which I attributed to the circumstance that mice always peel the seeds they eat, and, the sulphate being fixed principally in the episperm, the animal escapes the deleterious action of this salt.

Experiment 3.—I increased the proportion of sulphate of copper to 500 grammes per hectolitre of iron, by making 1 decilitre of seed take up 16 cubic centimetres of a solution containing 0.5 gr. of sulphate. After dessiccation, the pellicle of the corn had a very decided green tint. The corn employed in these researches contained, per decilitre, 2071 seeds; crystallised sulphate of copper containing per cent., 64 of anhydrous sulphate; in each seed there was therefore 0.24 milligr. of crystallised sulphate, or 0.154 of dry sulphate.

A mouse, placed under the bell-glass, ate, after peeling them, 70 seeds without appearing to suffer anything; at least it was allowed to escape, and ran away with great rapidity.

Experiment 4.—Some of the same corn was given to another mouse, placed under the bell-glass, and, to quench its thirst, 1 cubic centimetre of turnip, representing about 1 gramme of water was given to it. The mouse ate with appetite; it occasionally nibbled the piece of turnip. In three days, it had consumed 500 grains of corn, in which there must have been 77 milligr. of dry sulphate of copper; nevertheless, it retained all its vivacity. The bran which it left was in pellicles, in which, probably, was the greater part of the cupreous salt.

Experiment 5.—It appeared evident that the mice had escaped the action of the poison, owing to the instinct which leads them to peel the grains of cereals, an instinct which field-mice do not possess; there was therefore reason to believe that the latter animals would not have borne the regimen to which the mouse was subjected in the foregoing experiment.

A field-mouse was placed under the bell-glass with 1 cubic centimetre of turnip. A dozen of unprepared seeds were first given to it, which it devoured entirely, with its accustomed voracity, and without leaving the smallest fragment of bran. Some corn prepared with sulphate of copper was then given to it, and, to my great surprise, contrary to its habit, it ate the corn, rejecting the episperm, exactly as the mice had done; thus it was able, in three days, to eat 300 seeds of prepared corn in which there were 46 milligrammes of anhydrous sulphate of copper.

Experiment 6.—Another field-mouse, to which 320 of the same seeds prepared with sulphate of copper had been given, picked and crushed each grain, rejecting the pieces as soon as it had tasted them. This field-mouse died on the third day, but it would be difficult to say whether it died from the poison or from want of nourishment, for the greater portion of the food remained under the bell-glass.

As regards the question which these experiments were expected to solve, it is clear that preparation by means of sulphate of copper does not present the slightest guarantee against the destruction by vermin. Indeed, as we have seen, mice and field-mice eat with impunity corn, prepared with only a small quantity of sulphate of copper. When the salt of copper is added in larger proportion, as it does not seem to penetrate beyond the episperm, these animals escape its action by peeling the seed; and, supposing even, which is very improbable, that the field-mouse which died was killed by the poison, no advantage would be gained by this mode of preparation, because corn no longer germinates well when prepared with sulphate of copper in the proportion of 1,500 grammes per hectolitre.

Experiment 7.—I had several opportunities of proving that a field-mouse of the weight of 12 to 14 grammes, can scarcely bear privation of food for more than 30 hours; I also thought it advisable to ascertain how much corn it would consume in a day, this notion having a certain interest.

To a field-mouse placed under a bell-glass, I gave successively, and in such a way that it never wanted food, 940 grains of corn and 3 cubic centimetres of turnip. At the end of five days, 300 grains of wheat were left, the animal had consumed 640 grains without detaching the epidermis; or 128 per 28 hours. As there are 20710 grains in a litre (quart), we arrive at the conclusion that this litre of wheat would feed for one day 162 field mice; a thousand of these animals, if they took no other food, would eat 6.2 litres in a day. Now, as in an invasion similar to that which we suffered in 1854, some fields are infested with more than a million of field-mice per hectare, (about 2½ acres), the extent of the damage may be imagined, especially remembering that this animal not only eats the seed, but lays up a store of it for the winter.—*Journal d' Agriculture Pratique*, February 5, 1856.

(To be concluded in our next).

PHYSICS.

INFERENCES *from the* NEGATION of PERPETUAL MOTION.

By W. R. GROVE, Esq., Q.C., F.R.S., M.R.I.

SCATTERED among the writings of philosophers will be found allusions to the subject of perpetual motion, and here and there are arguments like the following: such a phenomenon cannot take place, or such a theory must be fallacious, because it involves the idea of perpetual motion: thus Dr. Roget advanced as an argument against the contact theory of electricity, as originally propounded, that if mere contact of dissimilar metals, without any chemical or molecular change, could produce electricity, then as electricity could, in its turn, be made to produce motion, we should thus get perpetual motion.

It may be well to define, as far as such a definition is possible, what is commonly meant by the term perpetual motion. In one sense, all motion, or rather all force, is perpetual; for example, if a clock-weight be wound up, it represents the force derived from the muscles of the arm which turns the key, the muscles again derive force indirectly from the chemical action of the food, and so on. As the weight descends it conveys motion to the wheels and pendulum; the former giving force off in the form of heat from friction, the latter communicating motion to the air in contact with it, thence to the case of the clock, thence to the air of the room,—proved in a very simple manner by the ticking heard, which is, in fact, a blow to the organ of hearing. Although ultimately lost to our senses, there is no reason to suppose that the force is ever in fact lost. The weight thus acting, reaches the ground quietly, and produces no effect at the termination of its course.

If, instead of being allowed to communicate its force to the works of the clock, the weight be allowed to descend suddenly, as by cutting the string by which it is suspended, it strikes the floor with a force which shakes the house; and thus conveys almost instantaneously, the amount of force which would be gradually dissipated, though not ultimately consumed, by the clock in a week or nine days.

This idea, however, of the perpetuity of force, is not what is commonly understood by the term perpetual motion: that expression is used to convey the motion of a motive machine, the initial force of which is restored by the motion produced by itself,—a clock, so to speak, which winds itself up by its own wheels and pendulum, a pump which keeps itself going by the weight of the water which it has raised. Another notion, arising from a confusion between static and dynamic forces, was, that motion might be obtained without transferring force, as by a permanent magnet. All sound philosophers are of opinion that such effects are impossible; the work done by a given force, even assuming there were no such thing as friction, aerial resistance, &c., could never be more than equal to the initial force; the theoretical limit is equilibrium. The weight raised at one end of a lever can never, without the fresh application of extraneous force, raise the opposite

weight which has produced its own elevation. A force can only produce motion when the resistance to it is less powerful than itself; if equal, it is equilibrium: thus, if motion be produced, the resistance, being less than the initial or producing force, cannot reproduce this; for then the weaker would conquer the stronger force.

The object of this evening's communication was not, however, to adduce proofs that perpetual motion, in the sense above defined, is impossible; but assuming that as a recognised truth to show certain consequences which had resulted, and others which were likely to result, from the negation of perpetual motion; and how this negation may be made a substantive and valuable aid to scientific investigation.

After Oersted made his discovery of electro-magnetism, philosophers of the highest attainments argued, that as a current of electricity, circulating in a wire round a bar of iron, produced magnetism, and as action and reaction are equal, and in contrary directions, a magnet placed within a spiral of wire should produce in the wire an electrical current: had it occurred to their minds that, if a permanent magnet could so produce electricity, and thence necessarily motion, they would thus get, in effect, perpetual motion, they would probably have anticipated the discovery of Faraday, and found that all that was required was to move the magnet with reference to the wire, and thus electricity might have been expected to be produced by a magnet without involving the supposed absurdity.

In a very different instance, viz., the expansion of water when freezing, not only heat, or the expansive force given to other bodies by a body cooling, would be given out by water freezing, but also the force due to the converse expansion in the body itself; and upon the argument that force would, in this case, be got out of nothing, Mr. J. Thomson saw that this supposed impossibility would not result if the freezing point of water were lowered by pressure, which was experimentally proved to be the case by his brother.

In the effects of dilatation and contraction by heat and cold, when applied to produce mechanical effects, and consequently in the theory of the steam-engine, this subject possesses a greater practical interest. Watt supposed, that a given weight of water required the same quantity of what is termed total heat (that is, the sensible added to the latent heat) to keep it in a state of vapor, whatever was the pressure to which it was subjected, and consequently, however its expansive force varied. Clement Desormes was also supposed to have experimentally verified this law. If this were so, vapor raising a piston with a weight attached would produce mechanical power; and yet the same heat existing as at first, there would be no expenditure of the initial force; and if we suppose that the heat in the condenser was the real representative of the original heat, we should get perpetual motion. Southern supposed that the latent heat was constant, and that the heat of vapor under pressure increased as the sensible heat. M. Despretz, in 1832, made some experiments which led him to the conclusion that the increase was not in the same ratio as the sensible heat, but that yet there was an increase—a result confirmed and verified with great accuracy

by M. Regnault, in some recent and elaborate researches. What seems to have occasioned the error in Watt and Clement Desormes' experiments, was the idea involved in the term latent heat, by which supposing the phenomenon of the disappearance of sensible heat to be due to the absorption of a material substance, that substance, "caloric," was thought to be restored when the vapor was condensed by water, even though the water was not subjected to pressure; but to estimate the total heat of vapor under pressure the vapor should be condensed while subjected to the same pressure as that under which it is generated, as done by M. Despretz and M. Regnault's experiments.

Carnot's theory, that the mechanical force is produced by the transfer of heat, and that there is no ultimate cost or expenditure of heat in producing it, was founded in part on similar considerations; it is true that mechanical *motion* may be produced by the transfer of heat from a higher to a lower temperature, without ultimate loss, or, practically speaking, with an infinitely small loss, but not, as he seems to think, an available mechanical force, except upon an assumption which he did not make, and to which allusion will presently be made. Thus, let a weight be supposed to rest on a piston confining air of a certain temperature, say 50° , in a vessel non-conducting for heat; part of this temperature will be due to the pressure exerted, since compression produces heat in air, while dilatation produces cold. If the air be now heated, say to 70° , the piston, with the weight attached, will rise, and the temperature, in consequence of the expansion of the air will cool somewhat, say to 60° , (the heat of friction of the piston may be taken to compensate the power lost by friction): if now a cold body be made to abstract 20° , the piston descending will, by its pressure, restore the 1° lost by expansion; and when the piston has returned to its first position, the original 50° will remain as at first. Suppose this experiment repeated up to the rise of the piston, but when the piston is at its full elevation, and the cold body is applied, let the weight be removed, so as to drop upon a wheel, or to be used for other mechanical purposes, the descending piston will not now reach its original point without more heat being abstracted; from the removal of the weight there will not be the same force to restore the 1° , and the temperature will be 49° , or some fraction short of the original 50° ; if this were otherwise, then as the ball in falling may be made to produce heat by friction, we should have more heat than at first, or a creation of heat out of nothing, in other words, perpetual motion.

Where force is abstracted from a thermal machine, we ought to lose heat, if we suppose the degrees of heat at a lower temperature to represent the same amount of force as the same number of degrees at a higher temperature; if, for instance, we suppose that a body cooling from 120° to 100° , gives off the same force as a body cooling from 20° to zero; this seems to be tacitly assumed by Carnot, but is probably not correct, the results of high-pressure steam, and other facts indicating a contrary conclusion. If then the 20° on the lower scale do not represent an equivalent force to the 20° on the higher, we *may* gain the same heat in degrees in the condenser as was lost from the furnace,

and yet get derived power. There is frequently a confusion between the work performed which returns to the machine, and the derived work, or that which does not return, and is used for other purposes. This is puzzling to the reader of treatises on the steam-engine, and kindred subjects, and has led to much obscurity of thought and expression.

M. Seguin, in 1839, controverted the position that derived power could be got by the mere transfer of heat, and by calculation from certain known data, such as the law of Mariotti, viz. that the elastic force of gases and vapors increased directly with the pressure, and assuming that for vapor between 100° and 150° centigrade each degree of elevation of temperature was produced by a thermal unit, he deduced the equivalent of mechanical work capable of being performed by a given decrement of heat; and thus concluded that for ordinary pressures about one gramme of water losing one degree centigrade would produce a force capable of raising a weight of 500 grammes through a space of one metre; this estimate is a little beyond that given by the more recent experiments of Mr. Joule. M. Seguin has, however, since the accurate and elaborate experiments of M. Regnault, necessarily varied his estimate, as by these experiments it appears that, within certain limits, for elevating the temperature of compressed vapor by one degree, no more than about 3-10ths of a degree of total heat is required; consequently, the equivalent multiplied in this ratio would be 1666 grammes, instead of 500. Other investigators have given numbers more or less discordant, so that without giving any opinion on their different results, this question may be considered at present far from settled. M. Regnault himself does not give the law by which the ratio of heat varies with reference to the pressure, and is still believed to be engaged in researches on the subject, one involving questions of which experiments on the mechanical effects of elastic fluids seem to offer the most promising means of solution.

One of the greatest difficulties which had presented itself to Mr. Grove's mind, with reference to the theory of Carnot, had been one of analogy, derived from the received theories of electricity. Many electrical cases might be cited in which no electricity is supposed to be lost, though a certain mechanical effort is produced by the electricity; if, for instance, a ball vibrates between a positively and negatively electrified substance, none of our electrical theories lead us to believe that any difference in the actual amount of electricity transferred would be occasioned by the ball being attached to a lever which would strike a wheel to produce any other mechanical effect.

In preparing this evening's communication an experiment had occurred to him, which, though performed with imperfect apparatus, and therefore requiring verification, does, as far as it goes, support the view derived from the negation of perpetual motion, viz. that when electricity performs any mechanical work which does not return to the machine, electrical power is lost. The experiment is made in the following manner:—A Leyden jar of one square foot, coated surface, has its interior connected with a Cuthbertson's electrometer, between

which and the outer coating of the jar are a pair of discharging balls fixed at a certain distance (about $\frac{1}{4}$ an inch apart). Between the Leyden jar and the prime conductor is inserted a small unit jar of nine square inches surface, the knobs of which are 0.2 inch apart.

The balance of the electrometer is now fixed by a stiff wire inserted between the attracting knobs, and the Leyden jar charged by discharges from the unit jar. After a certain number of these, (22 in the experiment performed in the theatre on this occasion,) the discharge of the large jar takes place across the $\frac{1}{2}$ -inch interval; this may be viewed as the expression of electrical power received from the unit jar. The experiment is now repeated, the wire between the balls having been removed, and therefore the "tip" or the raising of the weight, is performed by the electrical repulsion and attraction of the two pairs of balls; at 22 discharges of the unit jar the balance is subverted, and one knob drops upon the other, but *no discharge takes place*, showing that some electricity has been lost, or converted into the mechanical power which raises the balance. By another mode of expression the electricity may be supposed to be masked or analogous to latent heat, and would be restored if the ball were brought back, without discharge, by extraneous force.

This experiment has succeeded in so large an average of cases, and so responds to theory, that, notwithstanding the imperfection of the apparatus, Mr. Grove places much reliance on it; indeed, it is difficult to see, if the discharges or other electrical effects were the same in both cases, why the raising the ball being extra, and the ball being capable by its fall of producing electricity or other force, force would not thus be got out of nothing, or perpetual motion attained.

The experiment is believed to be new, and to be suggestive of others of a similar character, which may be indefinitely varied. Thus, two balls made to diverge by electricity should not give to an electrometer the same amount of electricity as if they were, whilst electrified, kept forcibly together, an experiment which may be tried by Coulomb's torsion balance.

There is an advantage in electrical experiments of this class, as compared with those on heat, viz. that though there is no perfect insulation for electricity, yet our means of insulation are immeasurably superior to any attainable for heat.

Similar reasoning might be applied to other forces; and many cases, bearing on this subject, have been considered by Mr. Grove in his essay on the "Correlation of Physical Forces."

Certain objections to these views were then discussed, and especially some apparently formidable ones presented by M. Matteucci in a paper published by him some time ago.*

This distinguished philosopher cites the fact, that a voltaic battery decomposing water in a voltameter, while the same current is employed at the same time to make an electro-magnet, nevertheless gives in the voltameter an equivalent of gas, or decomposed substance, for each

* Archives des Sciences Physiques, Vol. IV., p. 380.

equivalent of chemical decomposition in the cells, and will give the same ratios if the electro-magnet be removed. In answer to this objection it may be said, that in the circumstances under which this experiment is ordinarily performed, several cells of the battery are used, and so there is a far greater amount of force generated in the cells than is indicated by the effect in the voltameter. If, moreover, the magnet is not interposed, still the magnetic force is equally existent through the whole circuit; for instance, the wires joining the plates will attract iron filings, deflect magnetic needles, &c. By the iron core a small portion of the force is absorbed while it is being made a magnet, but this ceases to be absorbed when the magnet is made; this is proved by the recent observations of Mr. Latimer Clarke, which were fully entered into and extended by Mr. Faraday, in a lecture at the Institution (Jan. 20, 1854 *). It is like the case of a pulley and weight, which latter exhausts force while it is being raised, but when raised the force is free, and may be used for other purposes.

If a battery of one cell, just capable of decomposing water and no more, be employed, this will cease to decompose while making a magnet. There must, in every case, be preponderating chemical affinity in the battery cells, either by the nature of its elements or by the reduplication of series to effect decomposition in the voltameter, and if the point is just reached at which this is effected, and the power is then reduced by any resistance, decomposition ceases: were it otherwise, were the decomposition in the voltameter the exponent of the entire force of the generating cells, and these could independently produce magnetic force, this latter force would be got from nothing, and perpetual motion be obtained.

In another case, cited by M. Matteucci, viz. that a piece of zinc dissolved in diluted sulphuric acid gives somewhat less heat than when the zinc has a wire of platinum attached to it, and is dissolved by the same quantity of acid, the argument is deduced, that as there is more electricity in the second than in the first case, there should be less heat; but, as according to our received theories the heat is a product of the electric current, and, in consequence of the impurity of zinc, electricity is generated in the first case molecularly in what is called local action, though not thrown into a general direction, there should be more of both heat and electricity in the second than in the first case; as the heat and electricity due to the voltaic combination of zinc and platinum are added to that excited on the surface of the zinc, and the zinc should be, as in fact it is, more rapidly dissolved. Other instances are given by M. Matteucci, and many additional cases of a similar description might be suggested. But although it is difficult, perhaps impossible, to restrict the action of any one force to the production of one other force, and one only; yet if the whole of one force, say chemical action, be supposed to be employed in producing its full equivalent of another force, say heat; then as this heat is capable in its turn of reproducing chemical action, and, in the limit, a quantity equal or

* Proceedings of the Royal Institution, Vol. I., p. 345.

at least only infinitely short of the initial force ; if this could at the same time produce independently another force, say magnetism, we could, by adding this to the total heat, get more than the original chemical action, and thus create force or obtain perpetual motion.

The impossibility of perpetual motion thus becomes a valuable test of the approach that in any experiment we may have made to eliminating the whole power which a given natural force is capable of producing ; it also serves, when any new natural phenomenon is discovered, to enable us to ascertain how far this can be brought into relation with those previously known. Thus when Moser discovered that dissimilar metals would impress each other respectively with a faint image of their superficial inequalities ; that, for instance, a copper coin placed on a polished silver plate, even in the dark, would, after a short time, leave on the silver plate an impression of its own device, it occurred to Mr. Grove that, as this experiment showed a physical radiation taking place between the metals, it would afford a reason for the effects produced in Volta's contact experiment, without supposing a force without consumption or change in the matter evolving it. This led him to try the effect of closely approximating discs of zinc and copper without bringing them into metallic contact ; and it was found that discs thus approximated, and then quickly separated, affected the electroscope just as though they had been brought into contact. Without giving any opinion as to what may be the nature of the radiation in Moser's phenomena, this experiment removes the difficulty presented by that of Volta to the chemical theory of electricity.

The general scope of the argument from the negation of perpetual motion leads the mind to regard the so-called imponderables as modes of motion, and not as different kinds or species of matter ; the recent progress of science is continually tending to get rid of the hypotheses of fluids, of occult qualities, or latent entities, which might have been necessary in an earlier stage of scientific enquiry, and from which it is now extremely difficult to emancipate the mind : but if we can, as it is to be hoped we shall, ultimately arrive at a general dynamic theory, by which the known laws of motion of masses can be applied to molecules, or the minute structural parts of matter, it seems scarcely conceivable that the mind of man can further simplify the means of comprehending natural phenomena.—*The substance of a Lecture delivered at the Royal Institution, on Friday evening, January 25, 1856.*

TOXICOLOGY.

NOTE on the DETECTION of STRYCHNIA.

By MARSHALL HALL, M.D., &c.

THE detection of strychnia as a poison is, at this moment, of deep public interest.

When the *chemical* test fails, there remains, I think, another—the *physiological*. Having long studied the effects of strychnia on the animal economy, I am persuaded that these effects on the *most excitable*

of the animal species are at once the most delicate and specific tests of this poison.

I have just performed two experiments, and only two, for want of materials for more.

I requested Mr. Lloyd Bullock, of Hanover-street, to dissolve one part of the acetate of strychnia in one-thousand parts of distilled water, adding a drop or two of acetic acid.

I then took a frog, and having added to one ounce of water one-hundredth part of a grain of the acetate of strychnia, placed the frog in this dilute solution. No effect having been produced, one-hundredth of a grain of the acetate was carefully added. This having produced no effect, in another hour one-hundredth of a grain of the acetate was again added, making the three-hundredths, or about the thirty-third part of a grain. In a few minutes the frog became violently tetanic, and though taken out and washed, died in the course of the night.

I thus detected, in the most indubitable manner, one thirty-third part of a grain of the acetate of strychnia. It appeared to me that had more time been given to the experiment, a much minuter quantity would be detectible.

I placed the second frog in one ounce of distilled water, to which I had added the one-hundredth part of a grain of the acetate of strychnia. At the end of the first, the second, and the third hours, other similar additions were made, no symptoms of strychnism having appeared. At the end of the fifth hour, the frog having been exposed to the action of one-fiftieth part of a grain of the acetate of strychnia, tetanus came on, and under the same circumstances of removal and washing, as in the former experiment, proved fatal in its turn.

I thus detected one-fiftieth part of a grain of the poisonous salt by phenomena too vivid to admit of a moment's doubt; the animal, on the slightest touch, became seized with the most general spasmodic, or, rather, tetanoid rigidity. And this phenomenon, alternating with perfect relaxation, was repeated again and again.

As the nerve and muscles of the frog's legs, properly prepared, have been very aptly designated as galvanoscopic, so the whole frog, properly employed, becomes strychnoscopic.

In cases of suspected poison from strychnia, the contents of the stomach and intestines, and the contents of the heart, blood-vessels, &c., must be severally and carefully evaporated, and made to act on lively frogs just taken from the ponds or mud. I need scarcely say, that taken in winter the frog will prove more strychnoscopic than in summer, in the early morning than in the evening.

I repeated my experiment, placing one frog, fresh from the pools, in an ounce of water, containing the one-fiftieth part of a grain of the acetate of strychnia; a second in the same quantity of water, containing the one-sixty-sixth, a third containing one-hundredth, and a fourth containing one-two-hundredth. All became tetanic in two or three hours, except the third, which was a *female* (the others being males), which required a longer time.

The one-hundredth part of a grain of the acetate of strychnia is therefore detectible by means of this test conferred by physiology.

We now place a male frog in one-four-hundredth part of a grain of the acetate of strychnia, dissolved in six drachms of water. In three hours and a half it became violently tetanic.

The fresh frog is, therefore, at this season, strychnoscopic of one-four-hundredth part of a grain of the acetate of strychnia, and probably to a much minuter quantity, which ulterior experience must show.

In two other experiments, the one-five-hundredth and the one-thousandth of a grain of the strychnine were detected.—*Lancet*.

REMARKABLE EFFECTS of PERSULPHURET of IRON in SATURNINE POISONING.

SOME years since MM. Sandras and Bouchardat proposed persulphuret of iron as an antidote for lead, copper, corrosive sublimate and arsenic, and M. Sandras has used this valuable property of persulphuret of iron as the basis of a peculiar treatment in saturnine poisoning. The treatment proposed by M. Sandras is not however exclusive, for he not only endeavors to maintain in the digestive tube an excess of persulphuret of iron, intended to retain all the particles of lead excreted by the liver in an insoluble state until their final excretion, but he likewise removes all the poison remaining in the natural state, either internally or externally in contact with the organs, by soap baths and purgatives, and carefully alleviates each symptom of the poison. M. Sandras administers the persulphuret of iron in the form of syrup; he gives night and morning a dessert spoonful of a mixture of syrup and persulphuret of iron.

In one case a patient suffering severely from lead poisoning, had purged himself with aloes, but finding no improvement in his condition he placed himself under M. Sandras, who administered two dessert spoonfuls of syrup of persulphuret of iron, and a soap bath. In four days only a little cephalalgia remained, and he left the hospital.

In a second case the patient had been purged with castor and croton oils, and had taken some sulphur baths, which treatment appeared to have restored his health; but in three days every symptom of saturnine poisoning returned, and he in great agony placed himself under M. Sandras, who gave two spoonfuls of syrup of persulphuret of iron, and at night an opium pill of 0.03.

In three days the improvement was very great; the appetite returned. The persulphuret was continued. In three days more the pains assumed an intermittent form; and on the seventeenth day he was completely cured and was able to resume his occupation.

It will be observed that this treatment is especially valuable when the symptoms of saturnine poisoning have become chronic, when there are vague pains in various parts of the body, and the motive and nutritive powers are affected; which show that the poisoning has extended more deeply than mere saturnine colic, and leaves a deeper impression on the constitution. The persulphuret of iron appears to fill up an important gap in the treatment of saturnine poisoning.—*Bulletin de Théraputique*.

THE CHEMIST.

ORIGINAL COMMUNICATIONS.

On a MEANS of ESTIMATING the MONEY VALUE and STRENGTH of COMMERCIAL CYANIDE of POTASSIUM.

By THORNTON J. HERAPATH.

THERE is, I believe, no drug which is so frequently met with in an impure state as cyanide of potassium. This is owing not so much to the propensity which certain manufacturers appear to possess of adulterating the articles sold by them to the greatest possible extent, as to the difficulty which is experienced in preparing a pure article, and of purifying the impure cyanide after it has been manufactured. In a paper that was published in Liebig's *Annalen* for 1851, Professor Liebig has stated that commercial cyanide of potassium, prepared by his method, seldom contains more than 59 to 63·5 per cent. of pure cyanide. Having recently had occasion to purchase a considerable quantity of this chemical, I was induced to undertake a series of experiments, with the view of ascertaining the most expeditious method of testing the strength or money value of the various samples that were offered to me. The process I ultimately adopted was a modification of that proposed by Mr. Parkes for the determination of the per centage of copper in copper ores. It is based on the property which alkaline cyanides possess of decolorising the blue solution of cuprate of ammonia, or ammoniacal salts of copper. The first thing to be done in testing cyanide of potassium by this method, is to prepare a standard solution of ammonio-sulphate or ammonio-nitrate of copper. A certain known quantity of pure crystallised sulphate of copper,* made by crushing the pure crystals of the shops in a mortar, and pressing the powder so obtained between folds of bibulous paper, is taken, and dissolved in water, or an equivalent quantity of pure metallic (electrotype) copper is dissolved in dilute nitric acid; and the solutions so prepared are then diluted with water, so as to measure 2000, 3000, or more, water grain measures, at 60° F. Supposing 390·62 grs. of the pure sulphate, or 100 grs. of metallic copper, in the form of nitrate, to have been taken, and diluted to 2000 grain measures, every 100 grs. of such solution will, of course, represent 5 grs. metallic copper, or 6·25 grs. of the protoxide of copper. 100 grs. of each of the samples of cyanide of potassium to be tested,

* $\text{CuO}, \text{SO}_3 + 5 \text{Aq.}$

are then dissolved in a sufficient quantity of water, and introduced into the colorimeters ; an excess of ammonia is added, and the standard solution of copper is carefully added, out of a graduated burette, to the contents of each colorimeter in turn, until a faint blue coloration makes its appearance in each of the solutions. The quantities of copper, or of the solutions taken, then indicate the relative strength and money value of the samples of cyanide examined. Suppose, for example, one specimen took 100 measures, and a second 150 measures, of the copper solution, the relative strengths and values of such specimens are, therefore, as 100 to 150, or 2 to 3.

In order to render this process available in the determination of the actual strength of, or proportion by weight of pure cyanide of potassium existing in, the commercial cyanides, it is only necessary to ascertain the weight of pure cyanide of potassium that is required to decolorise 1 gr. of copper, in the form of ammonio-nitrate. I regret that the temporary loss of my note-book prevents me from giving the numerical result of my experiments on this point. The mode, however, by which this may be effected is as follows:—The strength of a solution of pure hydrocyanic acid (Scheele's acid) having been determined in the usual way, either by precipitation by silver, or by means of oxide of mercury, a certain known quantity of such acid, equivalent to 100 grs. of cyanide of potassium, is taken, and supersaturated by ammonia ; the alkaline solution so prepared, is then tested with the standard copper solution, in the manner before described. The latter can then, if necessary, be diluted with water, so as to render it of uniform and convenient strength.

“ On the ASSIMILATION of NITROGEN by PLANTS, and on the ACTION of NITRATES as MANURES.”

By THORNTON J. HERAPATH.

[Extract from a letter to Mr. John Watt.]

DEAR SIR.

The March number of THE CHEMIST contains translations of four valuable papers by MM. De Luca, Cloëz, Harting, and Ville, on the assimilation of the nitrogen of the air by vegetables, and on the natural formation of nitric acid in the soil. Having been for several years past engaged in investigating this subject, at the suggestion of the late Mr. Pusey, it may not perhaps be uninteresting were I to give you a short account of the conclusions at which I have arrived. They are as follows:—

1. That all soils contain an appreciable quantity of nitric acid, in the form of alkaline or earthy nitrates, (nitrates of soda or potassa, nitrate of lime, or nitrate of ammonia).

2. That some soils contain a much larger proportion of these salts than others do.

3. That some fertile soils contain as much as 3 to 6-1000ths of alkaline or earthy nitrates.

4. That the presence of these salts in the soil is to be ascribed partly to the presence of the nitric acid, and nitrate of ammonia in rain water, and partly to the formation of nitric acid, from the spontaneous oxidation of the nitrogen of the air, and of that of decomposing animal and vegetable matters, present in the soil, or added to it in the shape of manure.

5. That some soils possess the power of transforming free nitrogen and nascent nitrogen into nitric acid, in a higher degree than others.

6. That light porous soils generally effect nitrification more readily than dense and heavy soils.

7. That, *cæteris paribus*, a larger proportion of nitric acid is produced in hot, than in cold weather.

8. That the fertility of soil for certain plants appears to be caused by those soils possessing this property of transforming nitrogen into nitric acid in an eminent degree.

9. That nitrogen in the form of nitric acid, in general, acts better as a manure, than nitrogen in the form of ammonia.

10. That nitrogen usually acts best as a manure when in the form of nitrate of ammonia, or—when nitrogenous organic matter is present in the soil—as free nitric acid, or as nitrate of potassa, soda, or lime.

11. That nitric acid, free or combined, acts both as a stimulant and true manure.

12. That most plants possess the property of decomposing the alkaline and earthy nitrates, and of transforming them into protein or albumenised compounds; others, such for instance, as the beet, radish, tobacco (?), &c., store them up unchanged in their tissues; whilst a third class of plants, on the contrary, such as the nettles, *prunella vulgaris*, *datura stramonium*, *parietaria officinalis*, *borago* (?), &c., actually appear to possess the power of transforming ammonia or nitrogenous compounds into nitric acid.

I deeply regret that my departure from England will prevent me from furnishing you with the numerical results of my analyses, from which these conclusions were deduced.

Perhaps, however, at some future time, I may find leisure to prepare them for publication.

I remain, dear Sir, yours very truly,

THORNTON J. HERAPATH.

Old Park, Bristol.

CHEMICAL TABLES. COMPILED BY THORNTON J. HERAPATH.

SUPPLEMENTARY TABLES TO TABLE IV.

TABLE FOR TESTING BY THE BLOWPIPE. (Continued from p. 329.)

With Microscopic Salt, in the Reducing flame (R.F.)		With Borax, in the Reducing flame.		Substances.	REMARKS.
With Oxidising flame (O.F.)		Oxidising flame.			
Bead, colorless. Ditto. Ditto.	When added in excess, these basic beads which are <i>milky white</i> when cold; with oxide of lead, the bead is <i>yellowish</i> while hot.	As in the oxidising flame.	As with microcosmic salt.	25. Thorina. 26. Ytria. 27. Zirconia.	Is infus., B.B. Compounds containing thorina give a dark grey slag with nitrate of cobalt. (See 23.) Ditto. Ditto.
Ditto.	Even when saturated and cold; with oxide of antimony, antimonious acid, tungstic acid, and titanio acid, the beads are <i>yellowish</i> while hot; with molybdic acid, <i>green</i> .	Bead, <i>dark blue</i> while hot; <i>green</i> , when cold. Bead, <i>yellow</i> while hot; <i>violet</i> , when cold.		28. Molybdic acid.	On charcoal, fuses and is absorbed; reduced in form of small globules by strong R.F. It colors the flame green.
Ditto.		If iron is present, red; the addition of tin destroys the red coloration. Bead, <i>blue</i> .		29. Titanio acid.	Is not reduced on charcoal, even with the assistance of soda; the glass is not absorbed.
Ditto.				30. Tungstic acid.	Only partially reduced on charcoal; a mixture of metallic tungsten and yellow oxide is often obtained with soda, in R.F.

Bead, <i>colorless</i>. Ditto. Even when saturated and cold; with oxide of antimony, antimonious acid, tungstic acid, and titanlic acid, the beads are <i>yellowish</i> while hot; with molybdic acid, <i>green</i>.	Bead, <i>grey</i>, from reduced tellurium. Bead, <i>grey</i>, from reduced antimony.			31. Tellurium, oxides of. 32. Antimony, oxides of. On charcoal, is reduced with effervescence; the metal volatilises, and coats the charcoal with white oxide. On charcoal, in R.F., give metallic globules of antimony. The metal is <i>brittle, crystalline</i>, and <i>white in color</i>; is volatilised in the O.F., imparting a greenish blue color to the flame, and gives off white fumes of oxide of antimony.
Ditto. Ditto.	As in the oxidising flame.	As with microcosmic salt.		33. Mercury, oxides of. 34. Arsenious & arsenic acids. Compounds of mercury, when heated in a tube with tin or iron filings, yield a <i>grey sublimate of metallic mercury, which, when examined by a lens, is seen to consist of minute globules</i>. Arsenical compounds, when heated in a tube with black flax or cyanide of potassium, yield a <i>steel grey, mirror-like sublimate of metallic arsenic</i>. This, when heated in a current of air, <i>diffuses an alliaceous odor</i>, and yields a sublimate of arsenious acid, <i>crystallised in brilliant colorless octoedra</i>. Are easily reduced on charcoal, with soda, in R.F. <i>Metal very fusible, malleable, silvery white in color</i>; oxidises in O.F., and gives a <i>non-volatile white oxide coating the surface of the fused metal; areola, none</i>.
Ditto, even when saturated and cold.	As in the oxidising flame.	As with microcosmic salt.		35. Tin, oxides of.

With Microscopic Salt in the Reducing flame (R.F.)		With Borax, in the Oxidising flame.	Substances.	REMARKS.
Bead. colorless.	Even when saturated and cold.	As with microcosmic salt.	36. Tantalic or columbic acid.	Is not reduced on charcoal. Compounds of alumina, when moistened with nitrate of cobalt, <i>give a beautiful blue enamel</i> before the blow-pipe. Compounds of soda communicate a <i>bright yellow color</i> to the blow-pipe flame. Compounds of lithia color the flame <i>red</i> , if no soda is present. Compounds of potash color the flame <i>pale lilac, or violet</i> , if no soda is present. Compounds of ammonia, when heated with lime or potash, <i>give off ammonia gas</i> .
Ditto.			37. Alumina.	
Ditto.			38. Soda.	
Ditto.			39. Lithia.	
Ditto.			40. Potash.	
Ditto.			41. Ammonia.	

DIRECTIONS FOR TESTING BY THE ABOVE TABLE.

Fuse a globule of microcosmic salt on a platinum wire; add a small quantity of the substance to be tested, and again heat to redness in the oxidising flame; observe the color of the globule, and allow it to cool, and again note its color. The substance may thus be referred to one of six classes. If the globule is colorless, add a further quantity of the substance to be tested, and treat as before, in order to ascertain if the globule will become opaque on saturation. Then heat the same globule in the reducing flame, and again note its color. Repeat the operations with a globule of borax, and, if necessary, apply the special tests given under the head of Remarks, to individualise.

TABLE FOR TESTING BY CYANIDE OF POTASSIUM, AND ON THE SOLVENT POWER OF THAT REAGENT.

Behavior of the Soluble Salts of the Metals, &c., with a Solution of the Cyanide.		Behavior of certain Insoluble Compounds of these Metals towards a Solution of the Cyanide.	
Compounds of—	Color of Precipitate, &c.—		Are soluble in a solution of KCy, <i>in the cold</i> .
1 Copper, sub-oxide, give	A white curdy precipitate.	1. 2	Copper, prot-oxide, hyd.
2 " prot-oxide, "	A brownish-yellow precipitate, turning to siskin green.	3	Gold, metallic, recently precipitated.
3 Gold,	A yellow crystalline precipitate.	4	" oxide of.
4 Cobalt,	A flesh-colored precipitate.	7	Cobalt, sulphide, recently precipitated.
5 Iron, prot-oxide, "	A yellow-red precipitate (soluble in large excess).	8	Manganese, sulphide, recently precipitated (slowly soluble).
6 " per-oxide, "	A red-brown precipitate (partly soluble in excess).	9	Silver, metallic, recently precipitated.
7 Manganese, oxide, "	A brownish-red precipitate (?).	10	" chloride and iodide of.
8 Silver,	A white precipitate.	11	Cadmium, carbonate.
9 Cadmium,	A white gelatinous precipitate.	25	Zinc, carbonate.
10 Zinc,	Ditto.		" oxide.
11 Mercury,	A grey precipitate—(metallic Hg ?).		Mercury, sub-oxide of.
12 Chromium, oxides, "	A green precipitate.		Antimony, tersulphide, recently precipitated (slowly soluble).
13 Uranium, per-oxide, "	A splendid yellow precipitate (sparingly soluble).	25	Antimony, per-sulphide.
14 Platinum,	Ditto.	10	Zinc, sulphide, recently precipitated.
15 Palladium,	A pale yellow precipitate.	5, 6	Iron, sulphide, recently precipitated.
16 Nickel,	A pale apple-green precipitate.	16	Nickel, sulphide, recently precipitated.
		24	Tin, sulphides, partly soluble.
			Are sol. in a <i>hot</i> solution of the cyanide.

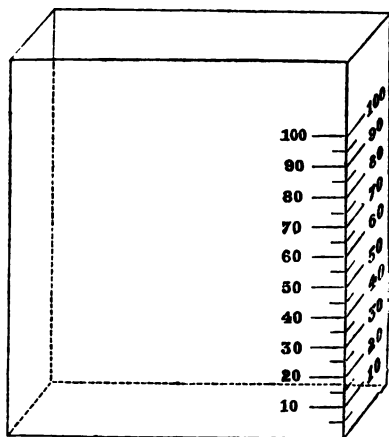
TESTING BY CYANIDE OF POTASSIUM, &c.—(Continued.)

Behavior of the Soluble Salts of the Metals, &c., with a Solution of the Cyanide.		Behavior of certain Insoluble Compounds of these Metals towards a Solution of the Cyanide.
17	Lead,	Are insoluble in the cyanide solution, <i>hot and cold</i>. Silver, sulphide of (?). [When precipitated, however, from a very dilute solution, the sulphide is completely soluble.] Cadmium, sulphide of. Mercury, sulphides of. Palladium, sulphide of. [But SH does not precipitate, PdS from the cyano-solution; on the addition, however, of NO₃ or HCl to the solution,—if the cyanide is not in too great an excess,—the PdS is precipitated.] Lead, carbonate of. Lead, sulphide of. Bismuth, carbonate of. Lime, carbonate of. Baryta, carbonate of. Strontia, carbonate of. Magnesia, carbonate of.
18	"	
19	"	
20	"	
21	"	
22	"	
23	"	
24	"	
25	"	
26	Potassium,	Insol. or but sp. sol. in excess, <i>hot or cold</i>. White precipitate. White precipitates being thrown down as carbonates or oxides. White precipitate of hydrate of alumina. Imperfectly precipitated as oxide. Ditto. No precipitate. Ditto. Ditto. Ditto.
27	Sodium,	
28	Lithium,	
29	Ammonium,	

IMPROVED COLORIMETERS. By THORNTON J. HERAPATH.

IN the last number of the *Chemical Gazette*,* Mr. J. W. Slater, of Sheffield, has given us a description of an improved colorimeter. "Chemists who use the ordinary tube colorimeter," says Mr. Slater, "often find some difficulty in comparing two colored solutions. Even though the tubes may be exactly of the same calibre, yet the eye is annoyed by the refraction of the light in passing through a body with a curvilinear surface." In order to do away with this difficulty, Mr. Slater recommends the employment of small glass cells, made by cutting from a stout glass tube, about $1\frac{1}{2}$ inches in diameter, a number of hoops or rings, about two-thirds of an inch in width, which are carefully ground at the edges, and then cemented down upon a strip of clear plate glass. All that is requisite, he says, in using this apparatus, is to fill the cells with the respective solutions to be compared, and place the apparatus upon a sheet of white paper, or to cover the whole with another slip of plate glass, equal in size to the one upon which the rings are cemented, and hold up the entire apparatus to the light. The upper plate, fitting closely upon the ground edges of the rings, prevents the solutions from escaping; and in this manner, shades of color may be distinguished, which, if the solutions were enclosed in tubes, might be confounded even by the most practised observer.

Mr. Slater's test colorimeter is certainly a very useful contrivance, but, in my opinion, the object in view may be effected in a much



simpler manner. Instead of employing tube colorimeters, I have long found it advisable to employ square or oblong glass cells, made by cementing together five pieces of plate glass with Canada balsam, or by fixing two pieces of plate glass in a framework of resinified wood or gutta percha. Colorimeters of this kind may be easily made of almost any dimensions, may be readily and accurately graduated; and by employing oblong glass cells, the chemist is enabled to test strong and weak solutions by the same apparatus with equal facility.

When a weak solution is to be tested, the operator looks through the long diameter; in the case of a strong solution, through the short diameter. For most purposes, however, a set of square or oblong white glass bottles will be found as serviceable as more expensive apparatus.

Old Park, Bristol.

* No. 321 (March 1st,) p. 89.

On the AMMONIO-SULPHATE of COPPER, and ZINC.

By THORNTON J. HERAPATH.

THE new and beautiful compound which forms the subject of the present note, was accidentally discovered by me, a short time ago, in the course of some experiments I have been making on the precipitation of copper, from an acid solution, by means of zinc, in the presence of a salt of ammonia. Having added an excess of ammonia to an acid solution of sulphate of copper, I supersaturated the excess of alkali by means of dilute sulphuric acid, and attempted to throw down the copper in the metallic state by a rod of zinc. Being compelled, however, to put the solution aside for some days, in consequence of being called upon to attend to other matters, I was surprised to find, on subsequently examining the vessel containing it, a beautiful efflorescence of silky blue needles, very similar in appearance to Lettsomite. I collected some of this crystalline efflorescence, and subjected it to a qualitative analysis, when I found it to contain sulphuric acid, ammonia, oxide of zinc, and oxide of copper.

A quantitative analysis gave me the following numbers:—

I. 3·7 grs. gave 0·372 grs. of oxide of copper, and 0·375 grs. of oxide of zinc.

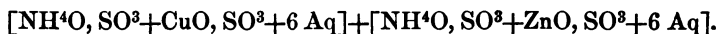
II. 4·6 grs. gave 5·43 grs. of sulphate of baryta=1·837 grs. of sulphuric acid.

III. 5·1 grs. gave 5·754 grs. of ammonio-bichloride of platinum=0·358 grs. of nitrogen, or 0·6648 grs. of oxide of ammonium.

These numbers, calculated to the 100 parts, give—

Oxide of copper	.	.	.	.	.	.	10·054
Oxide of zinc	.	.	.	.	.	.	10·135
Sulphuric acid	.	.	.	.	.	.	39·936
Oxide of ammonium	.	.	.	.	.	.	13·035

It is clear, therefore, that the composition of this salt must be represented by the formula—



	Atoms.	Per Centage Composition.
Oxide of ammonium	2	= 13·00
Sulphuric acid	4	= 40·00
Oxide of copper	1	= 10·00
Oxide of zinc	1	= 10·00
Water	12	= 27·00
		100·00

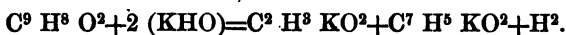
TRANSLATIONS AND ABSTRACTS.

ORGANIC CHEMISTRY.

On the ARTIFICIAL PRODUCTION of ESSENCE of CINNAMON.

By M. L. CHIOZZA.

THE division which certain organic acids, such as acrylic, angelic, and cinnamic acids, undergo under the influence of potassa in fusion, led me to undertake some experiments with the view of obtaining the aldehydes corresponding to these acids, by way of synthesis, by means of the aldehydes of more simple acids, into which they are divided by the agent indicated. On a former occasion, I demonstrated that, under the influence of potassa, cinnamic acid is divided into benzoic and acetic acids, according to the following reaction:—



It remained for me to realise the inverse reaction, that is to say, to produce cinnamic acid, or hydroguret of cinnamyle, with benzoic and acetic elements; it was this that led me to the experiment which I have the honor of communicating to the Academy.

A mixture of acetic aldehyde and hydroguret of benzoïle, saturated with hydrochloric acid, and gently heated, is colored of a deep brown, disengaging much hydrochloric acid, and a great part of the aldehyde which thus escapes the reaction.

After a few minutes, the mixture becomes turbid by the separation of small drops of water. If it be then submitted to distillation, we collect first unaltered hydroguret of benzoïle, then a small quantity of a less fluid liquid, which, purified by several rectifications and washings with alkaline solutions, presented to me the compositions and characters of hydroguret of cinnamyle. This mode of operating is not, however, advantageous, and I think that in repeating the experiment, it will be better to substitute sulphuric for hydrochloric acid, and to operate in close vessels.

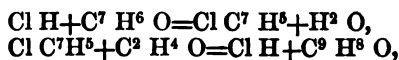
Be this as it may, the odor of the substance thus obtained is perfectly similar to that of the essential oil of natural cinnamon. This odor becomes particularly sweet when the substance begins to resinify.

When recently prepared, it is neutral to test papers, perfectly limpid and almost colorless; but by exposure to the air, it rapidly acidifies, and soon becomes colored. Long exposure resinifies it completely.

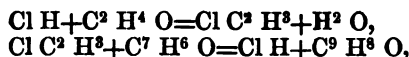
I regret having been unable to submit a more considerable quantity of my product to a comparative examination with the natural hydroguret of cinnamyle. However, the analysis of the substance, its mode of formation and its odor, leave me in no doubt as to its nature.

As to the manner of viewing the reaction between the two hydrogurets, I think that it must be regarded as an etherification, similar to that which most of the organic acids undergo in presence of the alcohols and hydrochloric acid.

It is probable that hydrochloric acid, in reacting on one or other of the two aldehydes, gives rise to the formation of the chlorides $\text{Cl C}^2\text{H}^3$ or $\text{Cl C}^7\text{H}^5$ which, reacting in their turn on the aldehydes, regenerate the hydrochloric acid and produce hydroguret of cinnamyle :—



or else



This mode of interpretation necessarily leads us to admit the existence of chlorides of non-oxygenised radicals, whose hydrates would be the aldehydes, and, perhaps, to modify the formula of constitution hitherto attributed to these substances. But as these formulæ are not absolute, and as their value depends only on the greater or less number of variations which they put in evidence, I do not think it right for the moment to refer the aldehydes to the type hydrate or rather to the type hydroguret.

Such, moreover, is also the opinion of M. Gerhardt, to whom I partly owe the ideas which have led me to the experiment which I have the honor of communicating to the Academy, and of which I hope very soon to be in a situation to publish the details.

Comptes Rendus, No. 5, Feb. 4, 1856.

RESEARCHES on IODURETTED PROPYLENE. THIRD MEMOIR: ALLYLE and COMPOUNDS of ALLYLE.

By MM. BERTHELOT and DE LUCA.

IN a Memoir presented to the Academy of Sciences, on the 16th of October, 1854 (*See THE CHEMIST*, Vol II., N. S., p. 153), we showed that glycerine, treated with iodide of phosphorus, gives rise to ioduretted propylene, $\text{C}^6\text{H}^5\text{I}$, a substance remarkable for its chemical activity.

Indeed, ioduretted propylene readily yields the iodine which it contains to the various agents with which it is put in contact, and thus produces, as much by substitution, as by simple or double decomposition, a great variety of new compounds. It thus resembles the hydriodic ethers corresponding to the ordinary alcohols, and gives, in general, the same reactions.

Thus, we have already, on one hand, substituted hydrogen for the iodine of ioduretted propylene and found propylene; and, on the other hand, we have transformed ioduretted propylene, by means of sulphocyanide of potassium, into oxide of potassium and essence of mustard.

In our first two Memoirs, we announced that we should pursue the study of the principal reactions of ioduretted propylene; we now publish the results of this study. These results are comprised in three principal propositions.

1. Ioduretted propylene forms, by double decomposition with the

salts of silver, iodide of silver, and conjugate compounds analogous to the ethers. M. Zinin has recently obtained combinations of the same order.

2. Ioduretted propylene, decomposed with oxide of mercury, produces an oxygenous compound, analogous to ether; decomposed by potassa in solution, in alcohol, amyle, or glycerine, it forms mixed ethers analogous to those of Mr. Williamson.

3. Ioduretted propylene, decomposed with sodium, loses its iodine, and forms a hydrocarbon analogous to ethyle. We shall designate this hydrocarbon by the name of *allyle*, applied, long since, by MM. Wertheim and Will to the nomenclature of the natural essences of garlic and mustard.

I. Action of Salts of Silver.—When we make 1 equivalent of ioduretted propylene react on 1 equivalent of dry butyrate of silver, we obtain a liquid, volatile at 145° C. (293° F.), and analogous, in odor and all its characters, to ordinary trityric ether. This is *allyle-butyric ether*.

Ioduretted propylene forms, with benzoate of silver, iodide of silver and a neutral compound, denser than water, soluble in ether, towards 230° C. (446° F.), quite similar to ordinary benzoic ether. It is *allyle-benzoic ether*, already made known by M. Zinin. Potassa slowly decomposes this ether, at 100° C. (212° F.), regenerating benzoic acid, and a volatile liquid, inflammable and miscible with water.

Ioduretted propylene forms, with tartrate of silver, iodide of silver, and a compound soluble in the ethers. This is *allyle-tartaric ether*.

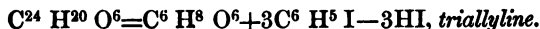
Ioduretted propylene, decomposed by the sulpho-cyanide of potassium or silver, produces *allyle-sulpho-hydrocyanic ether*, which is identical with essence of mustard.

II. Action of Oxide of Mercury and Alkalis.—Ioduretted propylene, treated at 100° C. (212° F.), with dry oxide of mercury, gives rise to a peculiar liquid, volatile between 85° and 88° C. (187° to 190° 4' F.), endowed with an ethereal and penetrating odor, resembling, to a certain degree, that of horse-radish. This liquid appears to be *allylic ether*.

Alcoholised potassa decomposes ioduretted propylene at 100° C.; it gives rise to a peculiar compound, volatile at 62° 5' C. (144° 5' F.), which appears to be *allylethyllic ether*.

Potassa, amylic alcohol, and ioduretted propylene, form, in the same way, *allyle-amylic ether*, volatile at about 120° C. (248° F.).

Finally, a mixture of potassa, glycerine, and ioduretted propylene, gives rise to a liquid of a sickening and disagreeable odor, soluble in ether, volatile at 332° (449° 6' F.) The analyses of this body lead evidently to the formula—



The foregoing facts show that ioduretted propylene presents the same general reactions as the hydriodic ethers, and forms, by double decomposition, conjugate bodies analogous to the ethers. The formula of the bodies thus produced is determined, almost with certainty, by

the very conditions of their formation. However, we must here declare, that the numerous analyses of their compounds which we have made do not agree exactly with the probable formula of the substances obtained. The allylic compounds are extremely difficult of purification.

These obstacles are due to the simultaneous and constant formation of accessory products, fixed as well as volatile, and, most frequently, gaseous propylene in considerable proportion. We observe, besides, that the allylic compounds are not produced by the simple play of two direct affinities, but in an indirect way, by inducing the formation of a very stable body (iodide of silver), and forcing, so to speak, the other elements to remain combined.

This instability of the allylic combinations under the very influence in the midst of which they are produced, is clearly shown by the following experiment:—if we try to produce these bodies by making butyric, benzoic, or stearic acids, act on allylic ether, in sealed tubes, between 200° and 250° C. (392° and 482° F.), a process by which one of us has directly prepared the ethers of the various alcohols, the following is observed:—there are developed a large quantity of inflammable gases, a black and ulmic substance, and a small quantity of a neutral butyric ether.

Thus, in the very conditions in which the ethers of the alcohol, properly so called, are obtained directly and absolutely pure, the allylic compounds are produced only in small proportion, and with destructive and gaseous disengagements, which show the intensity of secondary divisions.

III. Action of sodium.—The action of sodium on iodide of propylene is the simplest and clearest of all. It produces iodide of sodium, and a perfectly definite hydrocarbon,—allyle, $C^6 H^5$:—



Allyle is a very volatile liquid, endowed with a peculiar, ethereal, and penetrating odor, resembling that of horse-radish. It burns with a very luminous flame. It boils at 59° C. (138° 2' F.). Its density is equal to 0.684 at 14° C. (57° 2' F.). The density of its vapor, determined at 100° C. (212° F.), was found equal to 2.92. Consequently, the formula $C^6 H^5$ represents 2 volumes of vapor (density calculated, 2.89) the same as that of ethyle, methyle, &c.

Allyle mixes with sulphuric acid, disengaging heat; if we avoid elevation of temperature, the mass is scarcely colored; however, after a few hours, a great part of the modified carburet separates and floats.

Hydrochloric acid gas is not sensibly absorbed by allyle. Fuming nitric acid changes it into a neutral liquid compound, soluble in ether.

The action of the halogens is especially remarkable.

Allyle unites with chlorine, forming a liquid compound, denser than water, disengaging hydrochloric acid.

It combines instantly with bromine, disengaging heat. If the action be stopped at the moment when the liquid begins to be colored by an excess of bromine, and to disengage hydrobromic acid, and if it be treated with potassa, *bromide of allyle* ($C^6 H^5 Br^2$), a crystallised compound very soluble in the ether is produced. This body is volatile with-

out decomposition. It fuses at 37° C. (98° 6' F.), and can remain liquid at the ordinary temperature.

Iodide of allyle ($C^6 H^5 I^2$) is prepared by dissolving in 1 part of allyle, slightly heated, 6 or 7 parts of iodide; the mixture is at first liquified, then, after two or three minutes, it again becomes solid. The mass is bruised with an aqueous solution of potassa, and the iodide of allyle is crystallised in boiling ether.

This body, boiled with potassa in alcoholic solution, is decomposed, and gives a product whose odor is analogous to that of allyle; boiled with potassa in aqueous solution, it undergoes only an insensible decomposition, disengaging traces of inflammable gas.

Heated with a mixture of fuming hydrochloric acid and mercury, it is fully attacked, and does not disengage gas in appreciable proportion.

The formula of iodide of allyle, $C^6 H^5 I^2$, differs only by one equivalent of iodine from that of ioduretted propylene, $C^6 H^5 I$; therefore, we endeavored to convert each of these bodies into the other, or to prepare ioduretted propylene by means of allyle. But none of these experiments succeeded:—

1. When we make 3 parts of iodine (1 equivalent) react on 1 part of allyle (1 equivalent), the crystallised iodide, $C^6 H^5 I^2$, is formed, and the mixture retains the odor of allyle; heated with mercury and fuming hydrochloric acid, this mixture does not disengage any gas, but only the excess of liquid allyle which it contains.

2. Ioduretted propylene dissolves, with the aid of heat, a large quantity of iodine; but treatment by an aqueous solution of potassa removes this iodine, and causes the ioduretted propylene to re-appear with all its characters. Moreover, in the conditions in which it is formed, ioduretted propylene is always in contact with an equivalent of pure iodine, with which it does not combine.

3. Fuming hydrochloric acid and mercury convert ioduretted propylene into propylene, whilst they do not act on iodide of allyle.

This last body, when distilled, furnishes iodine, and a neutral liquid which hydrochloric acid and mercury do not convert into propylene.

These various facts prove, that ioduretted propylene, $C^6 H^5 I$, and iodide of allyle, $C^6 H^5 I^2$, have not the same relations between themselves, as the two iodides of mercury, for example: they correspond to two distinct molecular states.

Thus, the hydrocarbon being liberated by sodium, acting on the ioduretted propylene, does not present, with regard to propylene, the same relations as a real radical presents with regard to its iodide. For, in the first case, the results of the analyses are not confirmed by synthesis.

On the contrary, allyle presents these same relations with regard to the bromide of allyle; indeed, the bromide of allyle, treated by sodium, regenerates allyle with all its properties—odor, boiling point, property of forming, with iodine, a crystallised compound, &c. This agreement between the analytical and synthetical results, proves that the hydrocarbon, united to bromine in the bromide of allyle, exists in it in a molecular state, similar to that of allyle itself.

Comptes Rendus, No. 5, February 4, 1856.

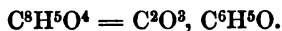
RESEARCHES on a NEW CLASS of ALCOHOLS.

By MM. AUGUSTE CAHOURS and HOFFMANN.

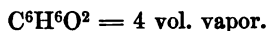
By submitting to dry distillation, glycerine, either alone or with the addition of bisulphate of potassa, or anhydrous phosphoric acid, M. Redtenbacher obtained a remarkable product, to which he gave the name of *acroleine*. The latter presents all the characters of an aldehyde, and, like vinic aldehyde, is changed, under the influence of oxidising bodies, into an acid, to which he gave the name of *acrylic acid*.

The researches of MM. Will and Wertheim on the essences of garlic and mustard, led us to compare these compounds of acroleine, analogies which were made evident by the recent work of MM. Berthelot and De Luca, relative to ioduretted propylene (see p. 396)—a body analogous to chloruretted and bromuretted propylene, obtained previously by MM. Cahours, Reynolds, and Hoffmann, and on the ultimate transformation of this product into essence of mustard by its action on sulpho-cyanide of potassium.

It remained, then, to find the keystone of this edifice, that is to say, the alcohol with which we might not only connect all the foregoing compounds, but also produce a series of bodies corresponding, either to the simple ethers, or to the compound ethers derived from ordinary alcohol. After many attempts, which long remained fruitless, we are enabled to produce the alcohol and the ether of this series, for which we will adopt the name of *acrylic series*, as well as a certain number of compound ethers. To arrive at this result, we made ioduretted propylene react on various salts of silver. It was thus that, in the mutual action of oxalate of silver and ioduretted propylene, we obtained iodide of silver and oxalate of acryle. The latter, separated from the iodide of silver, washed with water, dried over chloride of calcium, then distilled, occurs under the form of a colorless, limpid liquid, heavier than water, possessing an aromatic odor, resembling that of oxalic ether, boiling at 207° C. (404° 6' F.), to which analysis assigns a composition which agrees with the formula—

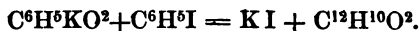


Treated by an excess of dry ammonia, this compound is converted into oxamide, regenerating the acrylic alcohol. The latter is a colorless liquid, very mobile, endowed with a pungent odor, resembling that of mustard, boiling at 103° C. (217° 4' F.), to which analysis assigns the formula—



Acrylic alcohol burns with a much more luminous flame than ordinary alcohol. It mixes, in all proportions, with water. Treated with potassium, it disengages hydrogen, and is converted into a gelatinous matter, which corresponds with potassiuretted alcohol. The latter is violently attacked by iodide of acryle (ioduretted propylene); iodide of potassium is abundantly deposited, at the same time that a colorless

liquid is formed, which is lighter than water, and entirely insoluble in it, and which corresponds to ordinary ether. The reaction is easily explained by means of the equation,



By treating potassiuretted alcohol with iodide of acryle, or potassiuretted acrylic alcohol with iodide of ethyle, iodide of potassium is formed, and a limpid, colorless, aromatic liquid is obtained, which is no other than a mixed ether, containing the radicals ethyle and acryle.

Potassiuretted phenol gives analogous results, by its action on iodide of acryle.

By distilling acrylic alcohol with the chloride, bromide, or iodide of phosphorus, we reproduce, with the greatest facility, the hydrochloric, hydrobromic, and hydriodic ethers of this series.

Acrylic alcohol dissolves, without coloration, in sulphuric acid of the highest degree of concentration, and gives a copulate acid, forming, with baryta, a soluble and crystallisable salt. This salt is anhydrous; analysis assigned to it the formula—



Anhydrous phosphoric acid attacks acrylic alcohol under the influence of a gentle heat. A colorless gas is disengaged, burning with a very luminous flame, which we have not analysed. According to all appearance, its composition should be expressed by the formula, C^6H^4 .

Acrylic alcohol is promptly attacked by oxidising agents. A mixture of sulphuric acid and bichromate of potassa acts on this body with extreme violence. The products of this reagent are acroleine and acrylic acid. Spongy platinum produces the same transformation. Finally, this same alcohol, treated by potassa and sulphuret of carbon, gives a compound which crystallises in beautiful yellow needles, resembling xanthate of potassa, and to which analysis assigns an analogous formula.

With the aid of alcohol itself, vinic acid or iodide of acryle, all the terms of the series are produced with the greatest facility. The following are some acrylic ethers obtained in this manner :—

Acrye-oxamethane, or oxamate of acryle, is formed by adding ammonia, by small portions at a time, to the oxalate of acryle, until oxamide begins to be formed. The filtered solution gives, by evaporation, magnificent crystals, soluble in alcohol.

Carbonate of Acryle is an oil lighter than water, which is easily produced by the action of sodium on the oxalate. An alcoholic solution of this compound, treated with baryta, gives carbonate of this base, regenerating the alcohol.

Benzoate of Acryle is easily produced by the action of chloride of benzoïle on acrylic alcohol. It is a liquid heavier than water, boiling at 220°C . (428°F .), possessing an aromatic odor analogous to that of benzoïc ether. Analysis assigns to this compound the formula :



The same body is easily produced by the reciprocal action of iodide of acryle and benzoate of silver.

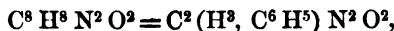
Acetate of Acryle obtained by the action of iodide of acryle on acetate of silver, is a colorless, very limpid liquid, lighter than water, and possessing an aromatic odor analogous to that of acetic ether. Analysis leads to the formula for this substance, of:



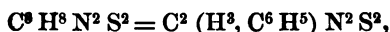
Cyanate of silver is briskly attacked, even cold, by iodide of acryle. The heat produced by the reaction is so intense as to cause the resulting compound to distil over almost entirely. We thus obtain a colorless, very limpid liquid, boiling at 82° C. (179° 6' F.), possessing an extremely penetrating odor, analogous to that of cyanic ether, and which produces abundance of tears. Analysis assigns to this product the formula—



It is *cyanate of acryle*. This compound is gently heated when mixed with ammonia, disappears promptly, and the liquor furnishes by evaporation a magnificent crystallised substance, which is no other than acrylic urea. Analysis assigns, indeed, to this compound, the formula—



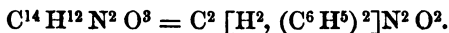
which differs from thiosinamine—



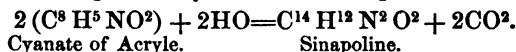
only in the sulphur being replaced in it by an equivalent quantity of oxygen.

Aniline produces with cyanate of acryle an analogous substance which crystallises with the greatest facility.

Heated with water, cyanate of acryle is at length entirely solidified. The product obtained in this manner presents all the properties and the composition of sinapoline, that is to say, of deacryle-urea. Indeed, the analysis which we have just made of this substance, leads to the formula—



Its formation is explained by means of the equation—



Cyanate of Acryle.

Sinapoline.

Cyanate of acryle is decomposed by boiling with a concentrated potassa ley; a concrete matter is very soon formed, which floats on the surface, and which is no other than this same sinapoline. The distilled product, collected in a cooled receiver, consists of a mixture of methylamine, propylamine and acrylamine. This latter distils between 180° and 190° C. (356° to 374° F.); it does not appear capable of forming, with bichloride of platinum, a very clearly crystallised salt.

It results from the experiments which we have just described, that there exists a new class of alcohols, of which acrylic would form the

third term. Like ordinary alcohol, acrylic alcohol furnishes a series of derivatives which may be formulised in an analogous manner.

The different known terms of this new series may, indeed, be formulised in the following manner, by comparing them with their correspondents of the vinic series :

$C^6H^5O^2$, acrylic alcohol	$C^4H^5O^2$, vinic alcohol
C^6H^5O , or $C^{12}H^{10}O^2$, acrylic ether	C^4H^5O , or $C^8H^{10}O^2$, ordinary ether
C^6H^5Cl , chloride of acryle	C^4H^5Cl , chloride of ethyle
C^6H^5Br , bromide of acryle	C^4H^5Br , bromide of ethyle
C^6H^5I , iodide of acryle	C^4H^5I , iodide of ethyle
$C^6H^5S^1$, sulphuret of acryle (essence of garlic)	C^4H^5S , sulphuret of ethyle
C^6H^5O , C^2S^4 , xanthate of acryle	C^4H^5O , C^2S^4 , xanthate of ethyle
C^6H^5S , C^2NS , sulphocyanide (essence of mustard)	C^4H^5S , C^2NS , sulphocyanide of ethyle
C^6H^5O , C^2NO , cyanate of acryle	C^4H^5O , C^2NO , cyanate of ethyle
C^6H^5O , C^2O^3 , oxalate of acryle	C^4H^5O , C^2O^3 , oxalate of ethyle
C^6H^5O , $C^4H^2NO^5$, oxamate of acryle	C^4H^5O , $C^4H^2NO^5$, oxamate of ethyle
C^6H^5O , CO^2 , carbonate of acryle	C^4H^5O , CO^2 , carbonate of ethyle
C^6H^5O , $C^4H^3O^3$, acetate of acryle	C^4H^5O , $C^4H^3O^3$, acetate of ethyle
C^6H^5O , $C^{14}H^5O^3$, benzoate of acryle	C^4H^5O , $C^{14}H^5O^3$, benzoate of ethyle
C^6H^5O , SO^2 , HO^2 , SO^3 , sulphacrylic acid	C^4H^5O , SO^2 , HO , SO^3 , sulphovinic acid
$C^6H^4O^2$, acrylic aldehyde	$C^4H^4O^2$, vinic aldehyde
$C^6H^4O^4$, acrylic acid	$C^4H^4O^4$, acetic acid
C^6H^6 , hydrocarbon (propylene)	C^4H^6 , hydrocarbon (acetene)
$C^6H^8N^2O^2$, acrylic urea	$C^6H^8N^2O^2$, ethylic urea
$C^{14}H^{12}N^2O^2$, diacrylurea (sinapoline)	$C^{10}H^{10}N^2O^2$, diethylurea
$C^8H^8N^2S^2$, sulphuretted acrylic urea (thiosinamine)	$C^6H^8N^2S^2$, sulphuretted ethylic urea

Acrylic alcohol, of which we have just sketched the principal properties, forms the third term of a series parallel to that which comprises ordinary alcohol, and which may be represented by the general formula—



and of which the two terms acrolein and acrylic acid have been known for several years.

We know, indeed, a group of homologous acids which are in the same position with regard to acetic acid as our alcohol is with regard to ordinary alcohol. Acryl-hydrocyanic ether, which we have not at present obtained in a state of sufficient purity to submit to the Academy, would present great interest, in as much as it would form, under the influence of potassa, an acid homologous to acrylic acid.

Comptes Rendus, No. 5, February 4, 1856.

NEW PROCESS *for* PREPARING FORMIC ACID.

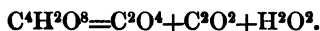
By M. BERTHELOT.

1. In a Memoir presented to the Academy, I have shown that oxide of carbon might be absorbed by potassa, fix the elements of water, and give rise to formic acid. This observation led me to seek whether it would not be possible to modify some of the reactions in which oxide of carbon is developed, in such a way as to combine this gas, in the nascent state, with the elements of water, and to obtain formic acid itself, easily and in abundance.

2. It is well known how troublesome are the present processes for obtaining this compound, the most simple of all organic acids. The ordinary way to obtain it is to treat sugar or starch with a mixture of sulphuric acid and binocide of manganese. This process is of great historical importance, for it enabled us to prepare formic acid without extracting it from ants, as was first done; but it is not free from inconveniences. Indeed, in the reaction just mentioned, a very great quantity of gas is developed; whence results the necessity for vessels of enormous capacity, which are frequently broken and corroded. Moreover, the acid obtained is mixed with various other substances, acid and neutral, produced simultaneously, which obliges us to purify the crude formic acid by converting it into formiate of lead, and crystallising this body several times. These difficulties have been observed by all chemists, and have doubtless more than once stood in the way of the preparation of large quantities of formic acid, and of its employment in reactions.

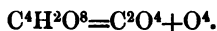
3. I have succeeded in producing this body very easily, and in considerable proportion, taking oxalic acid as a starting point.

Oxalic acid, submitted to the action of heat, is changed into carbonic acid, water, and oxide of carbon:—



At the moment of this decomposition, the water and oxide of carbon come in contact, in the nascent state; it should be sufficient, then, to secure the intervention of conditions suitable for combining these two bodies; already, from the single fact of the distillation of oxalic acid, this combination begins to be effected, according to Gay-Lussac's experiments; but the quantity of formic acid thus produced, is always very small.

Now, I have observed that we may combine with the elements of water, all the oxide of carbon furnished by oxalic acid, and simply transform this substance into carbonic acid and formic acid.



It is sufficient to introduce another body operating by action of contact—glycerine. I have already noticed this fact, and I shall now deduce from it a new process for preparing formic acid.

4. I operate as follows.

Into a retort, of the capacity of half a gallon, I introduce 1 kilogramme (about two pounds) of oxalic acid, 1 kilogramme of syrupy

glycerine, and from 100 to 200 grammes of water. I adapt a receiver and I heat the retort very gently; the temperature should scarcely exceed 100° C. (212° F.). A brisk effervescence is soon set up, and pure carbonic acid is disengaged. After about 12 or 15 hours, all the oxalic acid is decomposed; half of its carbon and oxygen are disengaged, under the form of carbonic acid gas; a small quantity of water, charged with formic acid, distils over, and there remains in the retort the glycerine holding in solution almost all the formic acid. This acid may be extracted directly, by means of carbonate of lead; but the following method is far preferable:—

Pour into the retort a pint of water and distil. Replace the water which distils over, and continue the operation until 6 or 7 quarts of distilled liquor has been collected. At this moment, almost all the formic acid is volatilised with the water; and the glycerine alone remains in the retort. It may be used for decomposing a second kilogramme of oxalic acid, a third, and so on.

3 kilogrammes of ammoniacal oxalic acid, $C^4H^2O^6 + 4HO$, yielded, by this process, 1·05 kilogrammes of formic acid, $C^2H^2O^4$.

According to the formula—



3 kilogrammes of pure oxalic acid should furnish 1·09 kilogrammes of formic acid.

The difference between the results obtained and the calculated result is as small as possible; moreover, it may be explained by the impurities which commercial oxalic acid contains.*

5. The following is the detail of the foregoing preparation:—

	kilogrammes.
Oxalic acid	1
Glycerine	1

We operated as has just been stated, and we obtained:—

1st. 2 litres of distilled liquid containing:—formic acid	gr. 146
2nd. 5·5 litres " " " "	176
	322

The glycerine still retained some formic acid. We added to the retort a second kilogramme of oxalic acid. We obtained:—

3rd. 1 litre of distilled liquid containing:—formic acid	gr. 70
4th. 4 litres " " " "	250
	320

The glycerine still retained some formic acid. We added a third kilogramme of oxalic acid. We obtained:—

5th. 2 litres of distilled liquid containing:—formic acid	gr. 180
6th. 4·5 litres " " " "	229
	409

* 100 parts of the acid employed, left a fixed residue equal to 2·7 parts.

To sum up:—3 kilogrammes of oxalic acid furnished 1·051 kilogrammes of formic acid.

This preparation is so regular that it may be executed without any difficulty, with any quantity, whatever, of oxalic acid. It does not require, moreover, much watching.

6. The only essential point, is not to hurry the decomposition of the oxalic acid by the glycerine. Indeed, if we operate too rapidly, if the temperature of the mixture rises too high, the disengagement of carbonic acid is at first accelerated; but as soon as it has ceased, the temperature of the mass very soon reaches from 190° to 200° C. (374° to 392° F.), and a new gaseous disengagement is produced; this is pure oxide of carbon. The liquid distilled throughout the operation thus conducted, does not contain one-tenth part of the formic acid which might be obtained by operating as I have said above.

7. This new phenomenon—disengagement of oxide of carbon—is due to the decomposition, at 200° C. (392° F.), of the formic acid retained in solution by the glycerine, in the same way as ammoniacal gas is dissolved by water. Indeed, pure formic acid, heated for some hours to between 200° and 250° C. (392° and 482° F.), in sealed tubes, is, for the most part, decomposed into water and oxide of carbon; the glycerine exerts scarcely any accelerating influence on this decomposition. These observations may be turned to account, in the preparation of oxide of carbon by oxalic acid; when, if we heat oxalic acid, mixed, not with sulphuric acid, but with glycerine, we obtain, successively and separately, the two gases which sulphuric acid mixed in equal volumes produces; first, carbonic acid, and then, carbonic oxide. This last body may, therefore, be thus prepared pure, without washing with alkali.

8. However, a considerable interval of temperature separates these two successive phenomena; decomposition at 100° C. (212° F.), of the oxalic acid into carbonic acid and formic acid, in contact with glycerine, then, further decomposition at 200° C. (392° F.), of formic acid into water and carbonic acid. Nothing is easier than to govern the reaction, and to obtain, by successive additions of water, the whole of the formic acid which oxalic acid can furnish.

Formic acid thus prepared, is very pure and completely free from oxalic acid. Saturated, by means of carbonate of lime, baryta, or lead, it furnishes by the first crystallisation, pure formiate of lime, baryta, or lead. 500 grammes of commercial oxalic acid produced about 500 grammes of pure formiate of lead.

It will be remarked, that the glycerine is formed entire in the retort, at the end of each operation (with the exception of a very small quantity—about 1 gramme per litre—volatilised with the water), exactly like sulphuric acid in the preparation of ether.

Comptes Rendus, No. 9, March 3, 1856.

INORGANIC CHEMISTRY.

RESEARCHES on TUNGSTEN and on some of its COMBINATIONS.

By M. A. RICHE.

To prepare the metallic tungsten, I had recourse to the reduction of tungstic acid by hydrogen and the action of sodium on the chlorides. When we pass a current of pure and dry hydrogen into a luted porcelain tube containing tungstic acid, and heat it to redness for at least two hours, by means of coke broken into small pieces, we obtain a matter which no longer contains oxygen. When we operate at a lower temperature, there always remains a more or less considerable quantity of inferior oxides.

The tungsten produced at this high temperature is not fused, or even aggregated; it occurs in small crystalline grains, capable of acquiring the metallic lustre by friction and easily scratching glass: placed in a forge fire so powerful as to soften the crucible, it remained in the solid state. Thanks to M. Despretz, who was kind enough to place at my disposal the battery of the Faculty of Sciences, I was enabled to fuse it, and it required for attaining this result the action of 200 ordinary Bunsen's elements; in these circumstances, a considerable quantity of the metal was oxidised, and gave in its combustion a blue flame, which, projected on a white screen in the dark, presented very beautiful tints.

Tungsten oxidises only at a very high temperature in the air or even in dry oxygen, and the action is slow. It does not burn in dry chlorine, and the temperature must be raised to about 800° C. (572° F.) for the action to take place.

Nitric acid, kept at 70° to 80° C. (158° to 176° F.) converts it, after three or four days, into tungstic acid. Aqua regia acts rather more quickly. Concentrated sulphuric and hydrochloric acids convert it into blue oxide, and after a long time this acid is converted into tungstic acid.

Aerated, distilled, or ordinary water, appears to have no action on it, even after six weeks' contact; it is the same with alkaline waters, whilst this same water, containing a little sulphuric acid, was colored thus; but the action is slow and very feeble. This metal does not attack water at 100° C. (212° F.), but at red heat the decomposition of water occurs with the greatest energy, the tungsten swells up, and is very soon converted into oxide.

When the tungsten is placed with iodide of ethyle in a tube sealed in a lamp, and heated to about 240° C. (464° F.), this metal is scarcely altered after ten days' contact; however, we see floating in the liquor small pearly needles, which are oxy-iodide of tungsten.

When the iodide of ethyle is replaced by iodide of methyle, the action is clearer; the distilled liquid gives, besides unattacked iodide of methyle, a viscid liquor boiling at a high temperature. If it be agitated with rather warm etherised alcohol, an oil separates, whilst the ether abandons by evaporation a substance which, suitably puri-

fied, crystallises in large colorless plates, fuses towards 110°C . (230°F .), and presents the composition—



This iodide, agitated with oxide of recently precipitated oxide of silver, produces a white powder, which is the oxide—



This body combines with the acids, and gives uncrystallisable salts, remaining, when concentrated, in the state of a viscid liquid, from which the alkalis reprecipitate the foregoing oxide. These salts are also produced, by acting on the iodide with the corresponding acids.

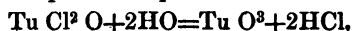
In order to determine the equivalent of tungsten, I relied on the reduction of tungstic acid, Tu, O^3 , the composition of which is generally admitted, by pure hydrogen. The weight of the water collected, and that of the tungsten remaining, lead to the formula 87; this number is lower than that hitherto admitted, and it could be no otherwise; for in this determination tungstic acid, mixed with alkali, was employed (because it was prepared by means of carbonate of soda); whereas I operated on pure acid obtained by the calcination of an ammoniacal salt, or precipitated by water from the pure and sublimed chloride.

Wishing to obtain tungsten by the action of sodium on the chloride, I first set about preparing on a rather large scale the red matter known by the name of chloride of tungsten, which has hitherto been procured by the action of chlorine on tungsten. I obtained it easily by directing a current of dry chlorine on a mixture of one part of tungstic acid and three parts of charcoal in powder, placed in a bitubulated stone retort heated to dull redness. To obtain it in the pure state, we have only to redistil it with care in a current of hydrogen; as it is more volatile than the other compounds produced in this reaction, it separates from them with facility.

This compound heated with sodium in a tube filled with hydrogen having always given me water and oxide of tungsten, I was naturally led to think that this pretended chloride contained oxygen; indeed, submitted to analysis, it gave numbers leading exactly to the formula,



Treated with water, the compound is rapidly decomposed into tungstic and hydrochloric acids; but when the experiment is made in a sealed tube and over mercury, it is proved, moreover, that hydrogen is not disengaged. This reaction, which is inexplicable in admitting the formula Tu Cl^2 , is very intelligible, on the contrary, when we recognise in this matter the composition represented above. Indeed, we have



There exist, however, chlorides of tungsten, and if we have not hitherto proved their presence, it is owing to their being changed into red oxy-chloride in contact with small quantities of water.

Trichloride of Tungsten.—This compound is obtained abundantly by directing a current of dry chlorine over very pure tungsten placed in a heated porcelain tube, and from which the air and moisture had

been previously expelled by means of dry hydrogen. It constitutes a matter crystallising by sublimation in long steel grey needles, which fuses at 218°C . (424°F .), and give a black liquid solidifying into a grey button, whose appearance and fracture resemble iodine. Water instantly decomposes it. Its analysis leads exactly to the formula—



Bichloride of Tungsten.—This body is prepared in very small quantities, when we reduce with hydrogen the foregoing chloride placed in a glass tube. The operation is stopped when no more hydrochloric acid is disengaged. There remains a small quantity of a blackish brown product, which presents on analysis the composition Tu Cl^3 . It is very difficult to keep within the narrow limits of temperature in which this reaction takes place. If it be heated too much, the trichloride is volatilised, and the product contaminated with metallic tungsten, a part of which is deposited on the sides of the tube as a beautiful brilliant ring.

Bisulphuret of Tungsten.—The sulphuret of tungsten corresponding to tungstic acid is obtained very easily; but it is not the same with the bisulphuret of this metal. I have prepared it in the pure state by a very simple means, which consists in heating together equal weights of bitungstate of potassa and sulphur in an earthen crucible, until the matter is in tranquil fusion. The residue is treated with water, which dissolves the tungstate of potassa, and the sulphuret is washed on a filter and afterwards dried. It is a black matter, crystallised in small needles, oxidising at a red heat in contact with the air, or at 50°C . (122°F .), in presence of nitric acid, and presenting exactly the composition of bisulphuret of tungsten.

Comptes Rendus, No. 5, February 4, 1856.

On BROMIDE of TITANIUM. By M. H. W. HOFFMANN.

LETTER TO M. DUMAS.

THE comparison of the boiling points of the corresponding compounds of chlorine and bromine, led M. Kopp to the interesting observation that these boiling points were raised, on the average, 32 centigrade degrees (57°F .), for each equivalent of bromine substituted for an equivalent of chlorine. Thus:—

			Differences.
Chloride of ethyle	$\text{C}^4\text{H}^5\text{Cl}$	11°C .	30
Bromide of ethyle	$\text{C}^4\text{H}^5\text{Br}$	41°C .	
Dichloruretted ethylene	$\text{C}^4\text{H}^4\text{Cl}^2$	67°C .	$66=2\times 33$
Dibromuretted ethylene	$\text{C}^4\text{H}^4\text{Br}^2$	133°C .	
Terchloride of phosphorus	PCl^3	78°C .	$97=3\times 32.3$
Terbromide of phosphorus	PBr^3	175°C .	

If this difference is uniform for all compounds of chlorine and bromine, it becomes evident that important conclusions, with regard to

the atomic composition of these substances, may be drawn from the determination of the boiling points of these bodies. This result has been ingeniously applied by M. Kopp, as a criterion of the determination of the equivalent of silicium, which had hitherto been so uncertain that there existed no less than three formulæ for silica :—



From the difference between the boiling point of the chloride ($59^\circ \text{C}.$), and that of the bromide ($153^\circ \text{C}.$), which difference was $94^\circ \text{C} = 3 \times 31 - 1$, M. Kopp was led to the formulæ—



as representing the atomic constitution of the chloride and bromide of silicium at $21 \cdot 3$.

However, in order to prove the general validity of the conclusion drawn by M. Kopp, it was necessary to re-examine the boiling points of the corresponding compounds of chlorine and bromine, in which deviations appeared, and to extend this enquiry to as many new bodies as possible. At my request, Mr. Francis Baldwin Duppa undertook some researches on this subject, and he has already obtained some results which will interest you.

The compound of bromine and titanium was unknown ; Mr. Duppa was enabled to produce this substance by passing a current of bromine over an intimate mixture of pure titanous acid and charcoal. The reaction took place at the red-heat, and furnished a brown liquid, which solidified into a crystalline mass in the receiver. Distilled over an excess of mercury, which took up all the free bromine, the bromide of titanium was presented under the form of an amber yellow body of a magnificent crystalline structure. It attracts moisture with the greatest rapidity, and is decomposed into hydrobromic and titanous acids. The bromide of titanium has the specific gravity of $2 \cdot 6$; it fuses at $39^\circ \text{C}.$ ($102^\circ 2' \text{F}.$). The boiling point, determined by Mr. Duppa with a considerable quantity of substance, the purity of which had been proved by analysis, was found to be $230^\circ \text{C}.$ ($446^\circ \text{F}.$). The boiling point, observed by yourself, is $135^\circ \text{C}.$ ($275^\circ \text{F}.$). The difference, $230 - 135 = 3 \times 31 \cdot 33$, is exactly the same as that which was already found between the boiling points of chloride and bromide of silicium.

This observation furnishes an additional proof of the analogy between titanium and silicium, at the same time that it evidently shows the formulæ—



as representing the atomic constitution of these two bodies.

Titanous acid, which has hitherto been considered as a binoxide, TiO^2 , would then take the formula TiO^3 , analogous to that of silicic acid.

The equivalent of titabromine, instead of $24 \cdot 29$, the number now adopted, would become $36 \cdot 39$. The protoxide of titanium, in this case, would become sesquioxide, and the compound, which hitherto has been regarded as the sesquioxide, would be considered as an in-

fermediate oxide, as a combination of the sesquioxide with the teroxide; in fine, as a bititanate of sesquioxide of titanium.

Formulae of the Compounds of Titanium.

Old Notation.	New Notation.
Ti=24.29	Ti=36.39
TiO, protoxide	Ti ² O ³
Ti ² O ³ , sesquioxide	Ti ⁴ O ⁹ =Ti ² O ³ +2TiO ³
TiO ³ , titanic acid	TiO ³ , titanic acid
TiCl ² , chloride	TiCl ³ , chloride
TiBr ² , bromide.	TiBr ³ , bromide.

Comptes Rendus, No. 7, February 18, 1856.

RESEARCHES on the CRYSTALLINE FORMS of some CHEMICAL
COMPOUNDS. By M. C. MARIGNAC.

In a work which I have just published on the crystalline forms of some chemical compounds, I have given a detailed description of the forms of forty-eight substances, most of which had not hitherto been determined. It is impossible to abstract such descriptions; but I will here notice some facts which result from my observations, and which may be more generally interesting to chemists.

The analyses of the sulphates of nickel which I have made, compel me to admit that an error has been committed in considering crystals as right rhomboidal prisms, and those in square octohedra as belonging to the same hydrate, and constituting a fact of dimorphism. The first contain, indeed, 7 equivalents of water, but the second, certainly only 6. I should remark, moreover, that the analyses of M. Mitscherlich, on which it is founded, agree better with my opinion than with the conclusion which has generally been drawn from them. Besides, this salt will not the less continue to present a case of dimorphism. Indeed, at a rather higher temperature than that which produces octohedral crystals, we obtain crystals in oblique rhomboidal prisms, which likewise contain 6 equivalents of water. These crystals do not retain their transparency at the ordinary temperature; they become opaque after a few hours, but without change in weight.

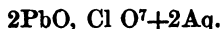
The sulphates of magnesia, cobalt, and zinc, also crystallise, with 6 equivalents of water, in oblique rhomboidal prisms, isomorphous with that of nickel. M. Mitscherlich had already noticed the existence of this second form, but I do not think that he has ever published the description of it.

I describe two hydrates of the neutral carbonate of magnesia, containing, the one 3, and the other 4, equivalents of water. They deposit, with time, in very fine crystals, from solutions of carbonate of magnesia, in water charged with carbonic acid. I received them from M. Morin, pharmacien at Geneva, who obtains them sometimes in very large quantity. If we join to it the crystals formerly described by

Brooke, we perceive that the carbonate of magnesia forms well defined compounds, perfectly characterised by their crystalline forms, with 3, 4, and 5, equivalents of water.

The form of the chlorate of silver, compared with that of chlorate of soda, will add a new argument to the opinion which holds that isomorphism may exist between forms belonging to two different systems. Indeed, we know that the salts of soda and silver are generally isomorphous. Now, whilst the chlorate of soda crystallises in cubes, that of silver occurs as a square prism, terminated by a square octohedra, placed on its angles, so as to form a dodecahedron, whose angles do not differ much from those of the rhomboidal dodecahedron of the cubic system.

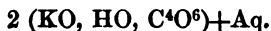
Perchloric acid forms several salts with oxide of lead, but I have only been able to obtain, in determinable crystals, only a bibasic perchloride, the composition of which is represented by the formula:—



This salt, which is very soluble, but not deliquescent, crystallises under two forms, which are incompatible, although they both belong to the system of the oblique rhomboidal prism. Its dilute solution is decomposed in contact with the carbonic acid of the air, and passes to the state of neutral perchlorate. Its concentrated solution, on the contrary, can also dissolve carbonate of lead, by aid of boiling, and afterwards furnishes crystals of a more basic salt, but which is rapidly decomposed, in contact with the air and water.

I give the description of the forms of the sulphates and chlorides of lurithanium and didymium. I think that it results from this study that the crystals described by M. Schabus, in an important Memoir, presented about a year ago to the Academy of Vienna, and referred by him to the chlorides of these metals, really belong to their sulphates.

The study of the crystals of binoxalate of potassa, led me to repeat the analysis of it. It is generally admitted, from old analyses, that this salt contains 2 equivalents of water of crystallisation. M. Rammelsberg, on the occasion of the publication of his "*Traité de Chimie Crystallographique*," performed the analysis of this salt, and assigned to it the formula:—



For my part, after several experiments, I am convinced that it contains no water of crystallisation, and that it is simply represented by the formula:—



It is true that I do not agree with M. Rammelsberg as to the form of the crystals of this binoxalate. He refers them to a right rhomboidal prism, whilst I make them out to be derived from an oblique prism. But the comparison of the angles shows that we have very evidently observed the same crystals, only, I think, that M. Rammelsberg has not measured the angles, which establishes indisputably the obliquity of the prism.

Among the salts which I have examined since the Memoir was printed, I may mention two which present a new example of isomorphism, exactly similar to that which exists between the chlorides of soda and silver. The isomorphism of the neutral iodates of potassa and ammonia has been generally admitted, the cubic form being attributed to these salts. I have established that this form belongs really to the iodate of potassa, but that the iodate of ammonia crystallises in a square prism. The relation of the vertical axis to the horizontal axis is that of 1.0135 : 1; a relation so near equality, that the disposition of modifications alone allows us to affirm that the form is prismatic, and not cubic.

Comptes Rendus, No. 6, Feb. 11, 1856.

INDUSTRIAL CHEMISTRY.

MEMOIR on the EMPLOYMENT of SULPHURET of CARBON as a MEANS of EXTRACTING FAT from BONES and the OIL of OLEAGINOUS SEEDS, and for SCOURING WOOL.

By M. E. DEISS.

In 1840, sulphuret of carbon was prepared in laboratories, either in bent gun barrels, or in small earthenware retorts. The commercial price at this period varied from 50 to 60 francs the kilogramme; I rapidly diminished the price of this product, and in 1848, sold at 8 francs the kilogramme, (about 3s. 3d. per lb.) to MM. Perroncel and Gerard, for the vulcanisations of caoutchouc by means of sulphuret of carbon and chloride of sulphur. Now, with an apparatus composed of three retorts, I manufacture, in my establishment at Pontin, the enormous quantity of 500 kilogrammes (above half a ton) in 24 hours. The same furnace, the same retorts, and the same fuel, only a year ago, produced only 150 kilogrammes in the same time; and this product, which, formerly, as I have said, was worth 60 francs the kilogramme, now costs me only 50 centimes (under 5d.) the kilogramme; and I doubt not, that, manufactured in larger quantities, it might soon be sold for 40 francs the 100 kilogrammes, (about £16 per ton.)

To this extreme cheapness, is added the advantage of its easy regeneration. Sulphuret of carbon requires 42° C. (107° 6' F.) to boil it; when a flask is filled with it, and put into a warm place, in which the hand can easily be borne, the sulphuret rapidly begins to boil. There is scarcely any absorption of specific heat. Not only does it readily enter into ebullition, but its vapors also condense easily, its distillation is radical, entire and without residue; in this it differs from the essences and ethers, which leave behind them, the former resinous residues, and the latter acid or alcoholic modifications of ether.

Being, thanks to the productive power of my apparatus, in possession of immense quantities of sulphuret of carbon, quite out of proportion to the sale, since, hitherto this product has only been employed for the

vulcanisation of caoutchouc, I have sought other industrial applications for it, and I have discovered one, which I regard as of the highest importance, the employment of the sulphuret as a means of extracting fatty bodies.

Paris produces 30,000 kilogrammes (about 30 tons) of bones per day, which go to the manufactories of charcoal or gelatine. The bones, on arrival at the manufactory are sorted, some for the manufacture of animal charcoal, others for the manufacture of gelatine and some (tibia fibula and femur) are sold again to the button-makers; but the immense majority is used for the manufacture of animal charcoal; not less than 25,000 kilogrammes per day are turned to this use, these bones before being calcined, undergo a preparatory process, for the purpose of extracting the fat. For this purpose, the bones are broken and boiled in large boilers with water for about three hours, the fat then floats, and is taken off, and the bones, thus deprived of fat, are removed, and thrown into a heap to undergo a species of fermentation, in which the production of heat leads to a certain state of dessication, which admits of the bones being calcined.

In the foregoing two operations, the bone undergoes a profound alteration; by the long decoction in water, a great quantity of gelatine, which is so necessary to the manufacture of a good charcoal, is dissolved out; but it is principally the fermentation and the forced exposure of the bone for some months to the air, which brings about the almost complete destruction of the animal matter, and consequently, a bad charcoal is produced, and all this for the sake of only 5 or 6 per cent. of fat.

I obtain much more advantageous results, by the application of sulphuret of carbon; I bruise the bones almost to powder, and heat them with sulphuret of carbon, which almost instantly dissolves all the fat contained in the bones, and this without any alteration of its animal matter; I distil, and I then obtain from 10 to 12 per cent. of fat of superior quality to that obtained by boiling.

The author makes known some processes, which he has devised for the application of sulphuret of carbon to the extraction of oils, from oleaginous seeds, and to the scouring of greasy wool. The grease removed from the wool by this method, itself becomes a useful product, it occurs in the form of a butyraceous substance, fit for making certain soaps.

Comptes Rendus, No. 5, Feb. 4, 1856.

AGRICULTURAL CHEMISTRY.

On the PREPARATION of SEEDS with ARSENIC.

By M. BOUSSINGAULT.

(Concluded from page 375.)

CONTRARY to my expectation, corn prepared with sulphate of copper, not acting as a poison to mice and field-mice, it was necessary to ascertain what would be the poisonous properties of seeds prepared with arsenic.

Liming, properly so called, that in which lime is used only for depriving of vitality the sporules of the cryptogamia, which are dreaded, and whose development it is desired to prevent, is performed by moistening the seed in such a manner as to make the lime which is sprinkled over it adhere. 11 or 12 litres (quarts) of water are sufficient for properly moistening 1 hectolitre of wheat, on which is spread about 2 kilogrammes of recently slaked lime. Thus prepared, the seed produces a crop, ordinarily free from ears, attacked by caries, but which, nevertheless, might be small, if a portion of the seed had been devoured by field vermin.

By associating the arsenic either with lime or with wood ashes, we doubtless add but very little to the property possessed by these different substances of preventing caries; but we certainly communicated to them the power of protecting the seeds against the voracity of vermin.

A litre of wheat was moistened with 1 decilitre of water, and sprinkled with—

Lime	20 grammes
Arsenious acid	2 „

The arsenious acid was mixed with the slaked lime. The limed seed, dried in the air, germinated very soon.

A mouse was put under the bell glass, at 1 o'clock, with 1 cubic centimetre of carrot, and 16 seeds of prepared corn, which it ate by picking them as squirrels do, that is to say, by seizing and raising the food with its two paws, which it rubbed together after eating, and which it frequently licked. At 5 o'clock, the mouse seemed to have lost its vivacity. Next day, at 8 o'clock in the morning, it was found heavy; it very soon began to eat, and occasionally nibbled the piece of carrot which had been given to it for the purpose of slaking its thirst; after 11, it took no more food; at 4 o'clock, it could scarcely stand, and at 5 o'clock, it died. It had eaten 56 seeds.

As there are 20,710 seeds in a litre of wheat, the two grammes of arsenic added to the lime, were so divided that each seed contained scarcely 0.1 milligrammes. The 56 seeds must therefore have contained 5.6 milligrammes; but if we consider that this poison adhered to the surface of the corn, it will be concluded that the animal, having skinned the seed, took only a very much smaller dose. This experiment proves that 56 wheat grains, limed, with the addition of arsenic in the proportion above indicated, killed a mouse.

Experiment IX. The foregoing experiment was repeated, the mouse being replaced by a field-mouse, which, eating the wheat without skinning it, was poisoned with fewer seeds.

At noon, a field-mouse placed under the bell glass, in which there was 1 cubic centimetre of turnip and 40 grains of prepared wheat, ate with rapidity, and, according to custom, without separating the episperm. At 5 o'clock, the animal felt the effects of the poison; it died in the night. There remained 5 seeds; 35 seeds containing 3.5 milligrammes of arsenic had been sufficient for the poisoning.

Experiment X. The corn must be rendered more poisonous by making the arsenious acid penetrate further into the interior of the seed. The sparing solubility of this acid, induced me to use arsenite of soda, which is a very soluble salt, easily prepared under the form of a metrical liquor, which enables us to determine very rapidly, the quantity of arsenic conveyed into the wheat.

100 grammes of arsenious acid, in very fine powder, were treated, hot, with water containing caustic soda; after cooling, it was filtered, and the acid which the alkaline ley had not dissolved was weighed:—

Arsenious acid employed	gr 100·0
Remaining undissolved	42·6
Dissolved	57·4

By an addition of distilled water to the solution, 1 litre of liquid was prepared, containing, in the state of arsenite of soda, 57·4 milligrammes of arsenious acid, and of which, consequently, 1 cubic centimetre represented 0·057 milligrammes. 1 decilitre of corn was made to absorb 12 cubic centimetres of water, containing 3·5 cubic centimetres of the metrical arsenical liquor, or 0·2 grammes of arsenious acid; and since the decilitre contains 2·0710 grains of wheat, each of these grains contained 0·1 milligramme of arsenic, in the state of arsenite of soda.

A field-mouse was put under the bell glass at 5 o'clock in the afternoon, with 1 cubic centimetre of carrot and 30 grains of prepared wheat; it ate immediately 10 grains, and then nibbled the carrot. After that, it ate no more. However, it retained its vivacity until 7 o'clock, when symptoms of poisoning manifested themselves. It died in the night, having left 30 seeds of wheat. Thus, 10 grains in which there was 1 milligramme of arsenious acid, caused death.

Experiment XI.—At 8 o'clock in the morning, a field-mouse was put into the bell glass, with 1 cubic centimetre of turnip and 40 grains of the prepared wheat already employed. After having eaten 8 grains and half the turnip, it touched no more food. At 8 o'clock in the evening it was dead. The 8 grains contained only 0·8 milligramme of arsenious acid.

Experiments X. and XI. seem to indicate that arsenious acid combined with soda has a more powerful poisonous property than in the free state. We have seen, for example, in experiment IX, that with wheat prepared by employing a mixture of slaked lime and arsenic, it required 3·5 milligrammes of arsenious acid, adhering to 35 grains of wheat, to kill a field-mouse. Now, we have just seen that about one fourth of this quantity was sufficient for producing the same effect, when the arsenic was in the state of arsenite of soda. It must, however, be borne in mind, that in liming with a mixture of hydrate of lime and arsenious acid, arsenite of lime must be formed, and as this salt is insoluble, it is probably less active as a poison than arsenite of soda, which is very soluble.

Arsenite of soda possesses an alkaline reaction; on this account, it

is extremely probable, that alone, this salt would act efficaciously against the development of the caries, and as it is poisonous in a very high degree, it would admit of our attaining both the objects aimed at in liming. The employment of a metrical solution of arsenite of soda, would likewise give to the operation of liming a precision which it is far from possessing at present, whatever may be the substances used; for, having once fixed, by a preliminary trial, upon the quantity of water which the seed will absorb, without becoming too wet, it it would be sufficient to introduce into this water, the proportion of arsenite of soda deemed necessary. Thus, for liming so as to make 200 grammes of arsenic penetrate into a hectolitre of the wheat which was used in these experiments, by making use of an arsenical liquor, similar to that the preparation of which I have described, it will be convenient to proceed as follows:—As I know that in an hour a hectolitre of this corn imbibes 16 litres of water, and that 1 litre of metrical arsenical liquor contains 57·4 grammes of arsenious acid, I shall prepare a liquid with—

Arsenical liquor	3·5 litres
Water	12·5 „
	16·0 „

The wheat being placed in a tube, the 16 litres of water are gradually added, the seed being constantly stirred. An hour after, it is spread out to dry. This would be a powerful arsenical liming, since, per hectolitre of wheat, in the arsenical liquor, the equivalent of 200 grammes of arsenic would have been added; but if thought sufficient, only 100 grammes or even less, might be added, and this would always be easy, the strength of the arsenical liquor being known.

It has been pretended, that, in order to protect the seeds from the ravages of animals, it is sufficient to communicate to them a powerful bitterness, by steeping them for some time in certain vegetable decoctions, such as those of colocynth, white hellebore, worm-wood, and, better still, in decoctions having both a disagreeable taste and poisonous properties, as an infusion of *nux. vomica*, &c. In my opinion, by employing these means, we fail in the principal object—I may even say, the only object sought—the destruction of the vermin injurious to seeds; for it is more than doubtful whether these latter substances have the property of preserving the crops from caries. Doubtless, the field-mice and mice would not touch grains of wheat or maize impregnated with such substances; but the seed would be protected from their attacks only for a few days, since germination would soon take place, and the radicles as well as the stems, into which the poisonous or bitter principle would certainly not pass, would feed these vermin. In my opinion, the seed sown must be eaten, and must be poisonous; it must be at once a bait and a poison.

Let us now determine how much seed is lost in destroying field-mice, in a field infested with them. I shall reason on the supposition, that the solvent has been *limed* with 200 grammes of arsenious acid, in the

form of an alkaline arsenite, per hectolitre. Experiments X. and XI. show that 10 grains of wheat killed a field-mouse; as there are 20,710 in a litre, this litre would suffice for killing 2,071 of these animals.

The opportunity of introducing a poisonous substance into the operation of liming, being once admitted, it may be asked what would be, during seeding time, the position of a farmer who had *limed* with the intention of destroying injurious animals, compared with those who had not taken the same precaution? I think that this comparison would not be disadvantageous, for the following reasons:—The poisoning of destructive animals has, in the first place, the effect of preserving the crop, which is the principal result; but there is another result, which although secondary, is, however, not to be despised; viz., that an animal injurious as it may be, during life, becomes eminently useful, after death, since it then acts as a powerful manure. What would this manure cost? The cost is easily reckoned, when we reflect that one litre of corn, limed with arsenic, will destroy 2,071 field-mice. Now, as I have ascertained that a field-mouse weighs about 15 grammes, it follows that for the price of a litre of corn, which is from 20 to 25 centimes (2*d.* to 2½*d.*), we have 41 kilogrammes (about three quarters of a hundred weight) of dead animals, or about 50 to 60 centimes (5*d.* to 6*d.*) for the quintal, representing 25 kilogrammes (about half a hundred weight) of dried flesh, blood, and bones, a manure every where transported to and spread upon the soil. At this time, I should with satisfaction see field-mice come to die on my land, and in the autumn of 1854, I would willingly have given a litre of corn to any one who would have brought me, in exchange, 41 kilogrammes of dead field-mice, for there would be in these 41 kilogrammes, in nitrogen and the phosphates assimilated by plants, the elements of more than 31 litres of corn.

The use of arsenic in liming, I readily acknowledge, presents much danger, by putting into the hands of many people so powerful a poison. It is known that the legislature has attached certain restrictions to its sale. It is especially from its resemblance to sugar, flour, starch and salt that arsenic in powder is dangerous: thus the accidents which it occasions, by imprudence or inadvertence, are numerous, and almost always fatal. It has been proposed to add to the arsenic intended for use in agriculture,* a small quantity of a mixture composed of sulphuret of iron and ferrocyanide of potassium; this means, if adopted, would prevent many accidents; for when arsenic thus prepared is added to milk, soup, or any liquid almost, it would immediately occasion a more or less dirty blue color, but always deep enough to attract immediate attention. The obstacles placed in the way of the sale of arsenic might thus be partially removed with so much the greater reason as we much doubt their efficacy, now that a fact of equal seriousness is allowed, and seems but little thought of. I speak of the free circulation of phosphuretted lucifers; these

* In England, as most of our readers are aware, arsenic must be colored when sold for such purposes.—Ed.

lucifers are everywhere. They are found, so to speak, in contact with our food; they are, notwithstanding, dangerous in the highest degree, and the symptoms which they occasion are doubly to be feared, for phosphorus is not only one of the most violent poisons; it is also the most incendiary substance we are acquainted with.

Journal d'Agriculture Pratique, Feb. 5, 1856.

PHYSIOLOGICAL & PATHOLOGICAL CHEMISTRY.

ACTION of the ALKALIS on the SUGAR in the ANIMAL ECONOMY.

By M. POGGIALE.

SOME observers are of opinion that the aid of the alkaline carbonates is necessary for the destruction of the sugar in the system, and, as a consequence of this theory, they suppose that, in diabetes, the passage of sugar into the urine is due to the want of alkali in the blood. This opinion having relation to a very serious affection, and to the therapeutical means which have been proposed for its treatment, I have instituted a series of experiments for ascertaining this fact.

In my experiments, the animals were fed, sometimes with meat, and sometimes with feculent or saccharine food, to which bicarbonate of soda was added, so as to render the urine very alkaline.

First Series of Experiments.—Dogs were fed for several days with meat, to which bicarbonate of soda had been added. They were afterwards killed, and the sugar contained in the blood and in the liver was estimated. The following are some of the results obtained:—

	Exp. I.	Exp. II.	Exp. III.
Blood of the crural artery	0·048	0·027	0·035
„ of the <i>vena cava</i> inferior	0·103	0·096	0·103
„ of the hepatic veins	0·173	0·150	0·139
Liver	2·029	2·115	„

It is easy to perceive the general consequence which flows from these experiments; namely, that the transformation of sugar into water and carbonic acid is not aided, as has been supposed, in the system, by the presence of a considerable proportion of alkali. We see, indeed, by comparing these results with those which I have given in my work on the origin of sugar in the animal economy (*See THE CHEMIST*), and with others obtained by various observers, that the blood of animals fed with meat, with or without bicarbonate of soda, contains the same quantity of sugar.

Second Series of Experiments.—Dogs were fed with feculent or saccharine aliments mixed with bicarbonate of soda. The following are the results furnished by these experiments:—

Sugar in 100 of Blood			
	Exp. I.	Exp. II.	Exp. III.
Blood of the <i>vena cava</i> inferior	0·198	0·153	„
„ of the carotid artery	0·100	„	„
„ of the crural artery	„	0·044	0·054
„ of the hepatic veins	„	0·243	0·239

In the last experiment, I examined daily the urine which furnished from 5 to 7 grammes of glucose per 1000, although they were strongly alkaline. These experiments demonstrate that sugar may exist in the blood and urine, even in the presence of alkalis.

In the course of these researches, I have observed that, when animals are subjected to complete abstinence, the proportion of sugar contained in the liver, decreases slowly, and does not disappear even in dogs which have fasted for twenty-two days, and devoted to certain death. In several experiments, I found, after ten days' abstinence, 1.710 of sugar in 100 of liver; after fourteen days, 1.628; after fifteen days, 1.712; after eighteen days, 1.613; and after twenty-one days, 1.624. The dog had lost in the last experiment more than 40 per cent. in weight.

Third Series of Experiments.—I injected, as MM. Bernard and Lehmann had done before me, half a gramme of glucose dissolved in distilled water, and I found the sugar in the urine. In a comparative experiment, I injected the same quantity of glucose mixed with 1 gramme of bicarbonate of soda, and the results were identical. When bicarbonate of soda is replaced in this injection by tartaric acid, the sugar most frequently does not appear in the urine. It results from these experiments, which have been repeated several times, and from those which I have formerly published, that the alkalis of the blood do not aid the oxidation of sugar.

Fourth Series of Experiments.—The foregoing experiments have shown that the presence of alkaline carbonates in the blood and urine is compatible with that of glucose. In order to give greater value to these facts, I carefully studied the action of the alkalis, and of the alkaline carbonates and bicarbonates, on glucose out of the organism. The following are some of the experiments which I have performed:—

1. I added to 100 grammes of distilled water 1 gramme of glucose and 2 grammes of carbonate of soda, and left the solution in the open air for several days; I found the quantity of glucose undiminished.

2. I augmented the proportion of carbonate of soda, and I successively raised the temperature to 37, 60, 80, and 90° C. (98° 6', 140, 176, and 194° F.), and in all these experiments the saccharine solution remained colorless, and the glucose underwent no alteration.

3. I dissolved in 100 grammes of distilled water, 2 grammes of glucose and 8 grammes of carbonate of soda, and after having boiled for fifteen minutes, I found in the liquor, which was at first yellow and then reddish yellow, 1.281 gr. of glucose.

4. Bicarbonate of soda acts with less energy on glucose. A solution of potassa containing 4 per cent. of alkali, attacks it only above 50° C. (122° F.).

These experiments are, in my opinion, decisive, and demonstrate that, in the laboratory, as in the animal economy, the alkaline carbonates do not act on glucose, and that the temperature of the mixture must be raised to about 95° C. (203° F.) for the action to take place.

Application of the Foregoing Experiments to Diabetes:—According to some physiologists, when the blood, from any cause whatever, loses its alkalinity, the sugar, not being burnt, passes into the urine,

whence the therapeutical indication of re-establishing the normal state of the animal fluids by introducing into the system the alkalis which are wanting. The facts contained in this Memoir do not admit of our adopting this theory, which is only founded on analogies. We have seen in the numerous experiments which we have performed, that by considerably increasing the alkalinity of the blood, the sugar is not diminished, and that the proportion of this principle may amount to 7 per 1000 in alkaline urine, when animals are fed with feculent or saccharine food, mixed with bicarbonate of soda.

We have also demonstrated, with MM. Bernard and Lehmann, that by injecting into the jugular vein of a rabbit, a solution of sugar, and bicarbonate of soda, we find in the urine as much sugar as when a solution of sugar alone was injected. Finally, we have proved, by unquestionable facts, that, even out of the animal economy, the alkaline carbonates do not act on glucose below 95° C. (203° F.), and that at this temperature it undergoes the metamorphoses which convert it into water and carbonic acid, so slowly that much sugar is still found in the liquor after long boiling.

The researches of MM. Lehmann and Bouchardat, on the blood of diabetic patients, and those of MM. Bernard and Reynoso, on the production of artificial diabetes, give a powerful support to the experiments which form the subject of this Memoir, and to the conclusion drawn from it.

Comptes Rendus, No. 5, Feb. 4, 1865.

PHYSICS.

*On the DISPOSITION of FORCE in PARAMAGNETIC and DIAMAGNETIC BODIES.**

By Professor TYNDALL, F.R.S.

THE notion of an attractive force, which draws bodies towards the centre of the earth, was entertained by Anaxagoras and his pupils, by Democritus, Pythagoras, and Epicurus; and the conjectures of these ancients were renewed by Galileo, Huyghens, and others, who stated that bodies attract each other as a magnet attracts iron. Kepler applied the notion to bodies beyond the surface of the earth, and affirmed the extension of this force to the most distant stars. Thus it would appear, that in the attraction of iron by a magnet originated the conception of the force of gravitation. Nevertheless, if we look closely at the matter, it will be seen that the magnetic force possesses characters strikingly distinct from those of the force which holds the universe together. The theory of gravitation is, that every particle of matter attracts every other particle; in magnetism also we have the phenomenon of attraction, but we have also, at the same time, the fact of

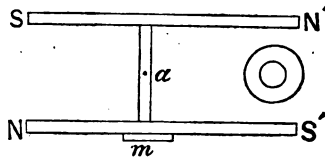
* The substance of a Lecture delivered at the Royal Institution, Friday evening, Feb. 1, 1856.

repulsion, and the final effect is always due to the difference of these two forces. A body may be intensely acted on by a magnet, and still no motion of translation will follow, if the repulsion be equal to the attraction. A dipping needle is exhibited: previous to magnetization, the needle, when its centre of gravity was supported, stood accurately level; but, after magnetization, one end of it was pulled towards the north pole of the earth. The needle, however, being suspended from the arm of a fine balance, it was shown that its *weight* was unaltered by its magnetization. In like manner, when the needle was permitted to float upon a liquid, and thus to follow the attraction of the north magnetic pole of the earth, there was no motion of the mass towards the pole referred to; and the reason was known to be, that although the marked end of the needle was *attracted* by the north pole, the unmarked end was *repelled* by an equal quantity, and these two equal and opposite forces neutralized each other as regards the production of a motion of translation. When the pole of an ordinary magnet was brought to act upon the swimming needle, the latter was attracted,—the reason being that the attracted end of the needle being much nearer to the pole of the magnet than the repelled end, the force of attraction was the more powerful of the two; but in the case of the earth, the pole being so distant, the length of the needle was practically zero. In like manner, when a piece of iron is presented to a magnet, the nearer parts are attracted, while the more distant parts are repelled; and because the attracted portions are nearer to the magnet than the repelled ones, we have a balance in favor of attraction. Here, then, is a most wonderful characteristic of the magnetic force, which distinguishes it from that of gravitation. The latter is a simple unipolar force, while the former is duplex or polar. Were gravitation like magnetism, a stone would no more fall to the ground than a piece of iron towards the north magnetic pole: and thus, however rich in consequences the supposition of Kepler and others may have been, it was clear that a force like that of magnetism would not be able to transact the business of the universe.

The object of the evening's discourse was to inquire whether the force of diamagnetism, which manifested itself as a repulsion of certain bodies by the poles of a magnet, was to be ranged as a polar force, beside that of magnetism; or as an unipolar force, beside that of gravitation. When a cylinder of soft iron is placed within a helix, and surrounded by an electric current, the antithesis of its two ends, or in other words, its polar excitation, is at once manifested by its action upon a magnetic needle; and it may be asked why a cylinder of bismuth may not be substituted for the cylinder of iron, and its state similarly examined. The reason is, that the excitement of the bismuth is so feeble, that it would be quite masked by that of the helix in which it is enclosed; and the problem that now meets us is, so to excite a diamagnetic body that the pure action of the body upon a magnetic needle may be observed, unmixed with the action of the body used to excite the diamagnetic.

How this may be effected, was illustrated in the following manner:—

An upright helix of covered copper wire was placed upon the table, and it was shown that the top of the helix attracted, while its bottom repelled the same pole of a magnetic needle; its central point, on the contrary, was neutral, and exhibited neither attraction nor repulsion. This helix was caused to stand between the two poles $N'S'$ of an astatic magnet; the two magnets $S N'$ and $S' N$ were united by a rigid cross piece at their centres, and suspended from the point a , so that both magnets swung in the same horizontal plane. It was so arranged that the poles $N'S'$ were opposite to the central or neutral point of the helix, so that when a current was sent through the latter, the magnets were unaffected by the current. Here, then, we had an excited helix which itself had no action upon the magnets, and we were thus at liberty to examine the action of a body placed within the helix and excited by it, undisturbed by the influence of the latter. The helix was 12 inches high, and a cylinder of soft iron, 6 inches long, suspended from a string and passing over a pulley could be raised or lowered within the helix. When it was so far sunk that its lower end rested upon the table, the upper end found itself between the poles $N'S'$, attracting one of them, and repelling the other, and consequently deflecting the astatic system in a certain direction. When the cylinder was raised so that the upper end was at the level of the top of the helix, its lower end was between the poles $N'S'$; and a deflection opposed in direction to the former one was the immediate consequence. To render these deflections more visible to the audience, a mirror, m , was attached to the system of magnets; a beam of light thrown upon the mirror was reflected and projected as a bright disk against the wall of the theatre: the distance of this image from the mirror being considerable, and its angular motion double that of the latter, a very slight motion of the magnet was sufficient to produce a displacement of the image through several yards. This, then, is the principle of the beautiful apparatus* by which the investigation now brought forward was conducted. It is manifest that if a second helix is placed between the poles $S N$ with a cylinder within it, the action upon the astatic magnet may be exalted. This was the arrangement made use of in the actual inquiry. Thus to intensify the feeble action, which it is here our object to seek, we have in the first place neutralized the action of the earth upon the magnets, by placing them astatically. Secondly, by making use of two cylinders, and permitting them to act simultaneously on the four poles of the magnets, we have rendered the deflecting force four times what it would be, supposing only a single pole to be used. Finally, the whole apparatus was enclosed in a suitable case, which protected the magnets from atmospheric currents, and the deflections were read off through a glass plate in the case, by means of a telescope and scale placed at a considerable distance from the instrument.



* Devised by Prof. W. Weber, and constructed by M. Leyser, of Leipzig.

A pair of bismuth cylinders was first examined. Sending a current through the helices, and observing that the magnets swung perfectly free, it was first arranged that the cylinders within the helices had their central points opposite to the poles of the magnets. All being at rest the number on the scale marked by the cross wire of the telescope was 572. The cylinders were then moved, so that two ends were brought to bear simultaneously upon the magnetic poles: the magnet moved promptly, and after some oscillations* came to rest at the number 612; thus moving from a smaller to a larger number. The other two ends of the bars were next brought to bear upon the magnet: a prompt deflection was the consequence, and the final position of equilibrium was 526, the movement being from a larger to a smaller number. We thus observe a manifest polar action of the bismuth cylinders upon the magnet; one pair of ends deflecting it in one direction, and the other pair deflecting it in the opposite direction.

Substituting for the cylinders of bismuth thin cylinders of iron, of magnetic slate, of sulphate of iron, carbonate of iron, protochloride of iron, red ferrocyanide of potassium, and other magnetic bodies, it was found that when the position of the magnetic cylinders was the same as that of the cylinders of bismuth, the deflection produced by the former was always opposed in direction to that produced by the latter; and hence the disposition of the force in the diamagnetic body must have been precisely antithetical to its disposition in the magnetic ones.

But it will be urged, and indeed has been urged against this inference, that the reflection produced by the bismuth cylinders is purely due to the currents of induction excited in the mass by its motion within the helices. In reply to this objection, it may be stated, in the first place, that the reflection is permanent, and cannot therefore be due to induced currents, which are only of momentary duration. It has also been urged that such experiments ought to be made with other metals, and with better conductors than bismuth, for if due to currents of induction the better the conductor the more exalted will be the effect. This requirement was complied with.

Cylinders of antimony were substituted for those of bismuth. This metal is a better conductor of electricity, but less strongly diamagnetic than bismuth. If therefore the action referred to be due to induced currents, we ought to have it greater in the case of antimony than with bismuth; but if it springs from a true diamagnetic polarity, the action of the bismuth ought to exceed that of the antimony. Experiment proves that the latter is the case, and that hence the deflection produced by these metals is due to their diamagnetic, and not to their conductive capacity. Copper cylinders were next examined: here we have a metal which conducts electricity fifty times better than bismuth, but its diamagnetic power is nearly null; if the effects be due to induction we ought to have them here in an enormously exaggerated degree, but no sensible deflection was produced by the two cylinders of copper.

* To lessen these a copper damper was made use of.

It has also been proposed by the opponents of diamagnetic polarity to coat fragments of bismuth with some insulating substance, so as to render the formation of induced currents impossible, and to test the question with cylinders of these fragments. This requirement was also fulfilled. It is only necessary to reduce the bismuth to powder and expose it for a short time to the air to cause the particles to become so far oxidised as to render them perfectly insulating. The power of the powder in this respect was exhibited experimentally in the lecture; nevertheless, this powder, enclosed in glass tubes, exhibited an action scarcely less powerful than that of the massive cylinders.

But the most rigid proof, a proof admitted to be conclusive by those who have denied the antithesis of magnetism and diamagnetism, remains to be stated. Prisms of the same heavy glass as that with which the diamagnetic force was discovered, were substituted for the metallic cylinders, and their action upon the magnet was proved to be precisely the same in kind as that of the cylinders of bismuth. The inquiry was also extended to other insulators: to phosphorus, sulphur, nitre, calcareous spar, statuary marble, with the same invariable results: each of these substances was proved polar, the disposition of the force being the same as that of bismuth and the reverse of that of iron. When a bar of iron is set erect, its lower end is known to be a north pole, and its upper end a south pole, in virtue of the earth's induction. A marble statue, on the contrary, has its feet a south pole, and its head a north pole, and there is no doubt that the same remark applies to its living archetype; each man walking over the earth's surface is a true diamagnet, with its poles the reverse of those of a mass of magnetic matter of the same shape and in a similar position.

An experiment of practical value, as affording a ready estimate of the different conductive powers of two metals for electricity, was exhibited, for the purpose of proving experimentally some of the assertions made by the speaker in reference to this subject. A cube of bismuth was taken and suspended by a twisted string between the two poles of an electro-magnet. The cube was attached by a short copper wire to a little square pyramid, the base of which was horizontal, and its sides formed of four small triangular pieces of looking-glass. A beam of light was suffered to fall upon this reflector, and as the reflector followed the motion of the cube, the images cast from its sides followed each other in succession, each describing a circle of about 30 feet in diameter. As the velocity of rotation augmented, these images blended into a continuous ring of light. At a particular instant the electro-magnet was excited, currents were evolved in the rotating cube, and the strength of these currents, which increases with the conductivity of the cube for electricity, was practically estimated by the time required to bring the cube and its associated mirrors to a state of rest. With bismuth this time amounted to a score of seconds or more; a cube of copper, on the contrary, was struck almost instantly motionless when the circuit was established.

TOXICOLOGY.

NOTE on the ACTION which RED PHOSPHORUS exerts on the ANIMAL ECONOMY, and on POISONING by ORDINARY PHOSPHORUS.

By MM. ORFILA and RIGOUT.

THIS note is a detached fragment of a work which we have undertaken on poisoning by phosphorus and the questions connected with it. The nature of the researches which we have thought necessary, being likely to prevent the conclusion of our work for a long time, we have decided on making known, at once, those of our experiments which relate to the action exerted by amorphous phosphorus on the animal economy. We experimented on dogs, administering to them red phosphorus, intimately mixed, by means of a pestle and mortar, with the Italian cheese with which we fed them.

First Experiment.—From the 28th to the 30th of July, we gave, in doses of 2 grammes each day, 6 grammes of red phosphorus to a healthy dog. On the 31st, we raised the dose to 5 grammes. We waited until the 7th of August, and then, finding that the health of the animal was not affected, we administered to him 2 grammes per day, until the 19th. At this date, the animal had swallowed 36 grammes of red phosphorus, from the commencement of the experiment. As no symptoms had supervened, we gave it, on the 21st, 2 grammes of ordinary phosphorus, and we tied the œsophagus. The animal died next morning.

Throughout the duration of this experiment, this dog passed with his fœces, red phosphorus which was perfectly recognisable, and, after taking the ordinary phosphorus, the fœcal matters gave out phosphorescent vapors.

Second Experiment.—The same day we gave to a bitch, very young, it is true, 50 centigrammes of ordinary phosphorus, suspended in olive oil, and the animal lived only a quarter of an hour.

Third Experiment.—On the 28th of November, we administered to a robust and very healthy bitch, 10 grammes of red phosphorus. She did not finish the food given to her until next day; but she did not give, besides, any sign of suffering. On the 30th, the dose was raised to 50 grammes, the animal devoured its entire meal instantly; but it very soon vomited. Next day, however, it was lively, and ate with appetite. On the 4th, 5th, 6th, and 7th of December, the same bitch took 20 grammes per day. On the 8th and the 10th, 30 grammes; and, finally, on the 11th, it consumed its ration which we had mixed with 50 grammes of phosphorus; but this time, it did not vomit. On the 12th, it ate with appetite. Altogether, without counting the 50 grammes which it had vomited, this bitch had taken 200 grammes of red phosphorus in 12 days.

We hanged her on the 12th, at 6 o'clock; on examination, we found no lesion; the œsophagus, stomach, and digestive tube, presented a red color, which could only be attributed to the amorphous phosphorus.

Fourth Experiment.—On the 21st of December, at 4 o'clock, we introduced into the stomach of a healthy dog, 2 grammes of ordinary phosphorus, coarsely powdered in hot water. Next morning the animal was dead.

Wishing to ascertain how long phosphorus could remain in the organs after death, in the state of free phosphorus, we delayed the autopsy until the 4th of January. What was our surprise, when we saw that the organs of this animal were as fresh as if death had only occurred a few minutes before? whilst another dog, which had not been poisoned by phosphorus, left only three days by the side of the former, was already in an advanced state of putrefaction.

In the œsophagus and in the stomach of the poisoned dog, we found a yellowish spumous matter which gave out the vapors of phosphorus. Placed in a metallic plate heated to redness, this matter burned at several points with a vivid white flame, and with thick vapors. From these characters it was easy to recognise the presence of free phosphorus.

We reserved this matter for some experiments.

The mucous membranes of the œsophagus and the stomach presented a vivid redness. The left auriculo-ventricular valvules presented, throughout their length, at the points of incision to the cardiac parietes, a very clear ecchymosis. The right auriculo-ventricular valvules were highly injected.

In order to separate the phosphorus mixed with the liquid found, and to characterise it, we placed this liquid in digestion with sulphuret of carbon, in a corked flask. Next day we filtered; the liquor, which passed through perfectly limpid, separated into two layers, the one aqueous and the other oleaginous, formed by the sulphuret of carbon. The latter was placed in a capsule, and left to spontaneous evaporation.

When all the sulphuret of carbon was disengaged, there remained a yellow mass possessing all the characters of phosphorus; luminous in the dark, giving out an odor of garlic, burning with a bright white flame, accompanied by thick white vapors; and, finally, leaving by evaporation a red residue.

This experiment, which shows that 2 grammes of ordinary phosphorus are sufficient to kill a dog, fixed our attention in an especial manner, from some peculiarities which it presented; it shows, indeed, that after poisoning by phosphorus:—

1. This body may exist in the organs, in the free state, fifteen days after death. This fact, which had been only vaguely anticipated, has not been, so far as we know, observed until now. It is possible, moreover, that phosphorus may be preserved much longer in the same state, and it is easy to understand what advantage, in analogous cases, a chemist instructed to prove a poisoning, may draw from this observation.

2. Putrefaction is, in certain cases, singularly retarded.

3. Sulphuret of carbon is a good solvent for separating free phosphorus from the matters with which it is mixed in the stomach, and which disguise the characteristic properties of this metalloïd.

The foregoing remarks have appeared to us worthy of mention, but we have cited this last experiment chiefly, because it concurs with the others, in demonstrating that the action exerted on the animal economy by amorphous phosphorus, is not comparable with that which ordinary phosphorus produces. It may indeed be said, that the first of these bodies is not poisonous. This assertion, already advanced by other observers, without sufficient proof, has been indisputably established only by the whole of the experiments which we have just detailed.

Comptes Rendus, No 5, February 4, 1856.

NOTES on the PHYSIOLOGICAL and THERAPEUTIC EFFECTS of the
CHLORIDE of AMMONIUM.

By ALEXANDER LINDSAY, M.D.

It has been frequently remarked that our *Materia Medica* is sufficiently extended. Substances have doubtless been included amongst our medicines that perhaps ought not to have been accounted such. Yet it is as likely that many that have had a merely passing reputation—that have been named only to be left unheeded—may, nevertheless, not be so useless as their neglect would seem to indicate. How this should happen it is unnecessary to inquire. It is probable, however, that, in many cases, a lauded remedy is trusted, without, at the same time, attending to those general indications which an enlightened treatment would direct to be conjoined. This is no mere supposition;—and thus it is that the therapeutic effect of even a useful medicine may be completely lost. In the treatment of chronic disease, the practitioner is often disappointed in the action of medicines, even with those that a large experience has shown to be useful. The causes that lead to this result are often difficult to discover. They may reside in the medicine; more frequently, however, they depend on peculiarities in the constitution of the patient. In such cases, a change of remedy is often attended with the happiest results, and hence the advantage of having at our command medicines whose actions are allied.

I have made these remarks preliminary to the urging on the notice of the profession an important medicinal agent, already included in our *Materia Medica*. I refer to the chloride of ammonium (NH_4) *muriate of ammonia*, or *sal ammoniac*, as it has been variously named. Internally it is seldom prescribed in British practice, although its external employment is not so rare. On the continent it is otherwise. In France, but particularly in Germany, writers on the *Materia Medica* inform us that its internal administration is frequent. The knowledge of this fact induced me, some years since, to give it a trial, and since then I have recommended it to the attention of others. My experience of its advantages, conjoined with that of those who acted on my suggestion, have prompted the endeavor to secure for it a more general trial.

Iodine, bromine, and chlorine are readily distinguished the one

from the other; yet, in some respects, they are physically allied, and they are so closely related chemically, that they have been grouped as a family. Further, there is a marked similarity as regards the therapeutic effect of the salts, resulting from their union with metals. These considerations, coupled with the assumed nature of the basyl ammonium, would naturally lead to the conclusion that the action of the chloride, in diseased states, would be of a character similar and equal to others held in higher repute; my own experience of the salt has shown such to be the case.

It may be useful to refer briefly to the physiological actions of the medicine under consideration. A knowledge of these cannot, it is true, serve as a guide to its employment in disease, yet it will enable us to measure its influence on the system, and to conclude in a general manner as to its therapeutic action. For where a physiological change in any given case is not observed, but little alteration is to be expected in morbid conditions.

The information possessed regarding the actions of the chloride on the healthy body is very limited. Pereira's *Elements of Materia Medica* contains all I have been able to glean on the subject. The statements there, however, refer to large doses; that author remarks as follows:—"Its local action is irritant. Its chemical influence is not very obvious. It dissolves mucus, but does not coagulate albumen. Weber tried the salt on himself. He took from ten to twenty grains for a dose, which he repeated at the end of an hour. The effects were a sensation of warmth and oppression in the stomach, headache, and increased desire of passing urine." So far as I am aware, the influence of medicinal doses, continued for a certain time in healthy individuals, has not been recorded. I was anxious to ascertain this, and have been aided in the inquiry by two intelligent pupils, who willingly agreed to subject themselves, along with me, to the action of chloride. Daily, for a week previous to the experiment, the state of the appetite, the nature and amount of the food, the condition of the bowels, the frequency of the pulse, with the amount and density of the urinary secretion, were carefully noted. The medicine was then taken for a week, and similar observations recorded. The amount taken was in one case 18 grains per day, a second 13½ grains, and the third 9 grains. These quantities were divided into three equal doses, and were swallowed dissolved in two ounces of water. No comparison of the result was made till the observations were concluded. The following is a brief summary of these, from the notes now before me:—

On the second day after beginning the medicine, a buoyancy of the system was experienced that rendered ordinary pursuits a pleasure, and fitted body and mind for increased exertion. The uniformity of this result was the more remarkable as the experimenters represent types of the nervous, sanguineous, and lymphatic temperaments respectively. The feeling was least developed in the last. He employed the smallest dose. In all, the appetite was much improved. Where the smallest quantity of the salt was taken, the amount of food was

double. The feculent discharges were in all much augmented. The mucous follicles of the intestinal tube seemed to be stimulated to a much increased secretion. In two, the force and frequency of the heart's action were diminished. The rate of the pulse in the gentleman employing the smallest dose was accelerated. In all, the chloride increased the urinary secretion. It cannot, however, be classed as a renal hydragogue. The increase of fluid ranged from six to twelve ounces in the twenty-four hours. In the two cases, where the largest and smallest doses were used, it acted as a renal depurant, the excess of solids varying from 70 to 160 grains daily. In the other, no change in this respect was noticed; but it may be necessary to remark, that the effect on the bowels appeared to be greatest in the individual making use of the medium dose.

The cases in which I have employed the chloride of ammonium in practice have been limited to chronic diseases, such as result from inflammatory action, or where there is a local ailment existing as the expression of a dyscrasial condition. Particularly, I have prescribed the salt in cases of chronic bronchitis, in enlargement of the lymphatic glands, whether resulting from scrofulous disease or dependent on a syphilitic taint, in chronic skin diseases, and in cases of chronic rheumatism.

The chloride has been, I may remark, exhibited also in acute diseases; in some forms of fever, and in the milder cases of pneumonia.* Further, Dr. Watson, in his lectures, has testified as to its efficacy in certain forms of facial neuralgia;† and Dr. Ebdon, in the *Indian Annals of Medical Science* for April, 1854, states that it is a powerful and valuable remedy for the relief of neuralgic pain generally. He writes—"In facial neuralgia, tic douloureux, nervous headache and toothache, not excepting sciatica, and even in one case of neuralgic dysmenorrhœa, I have often given it, and been convinced, after a full trial, of its merits."‡

Of its therapeutic effects in acute diseases, I have no knowledge, nor have I prescribed it in neuralgic affections; but, from what I have seen in its physiological action in small doses, I can readily believe that the quantities prescribed by Dr. Ebdon must have had an important influence.

I commenced the use of the salt in morbid conditions of the pulmonary mucous membrane, where the exuded (mucus) secretion was tough and tenacious. In such cases, its action was often remarkable, the exudate becoming speedily altered in quality and consistency. It has probably been from observing this effect that some have attributed to the chloride of ammonium qualities similar to the mercurial preparations. As liquefacients their influence is well known. On this account they are frequently employed. But in cases in which their

* Neligan on Medicines and their Uses, p. 359, 4th edition.

† Watson's Lectures, 3rd edition, p. 717.

‡ Rankin's Half-yearly Abstract, vol. xx. p. 52, and *British and Foreign Medico-Chirurgical Review* for July, 1855, p. 236.

use in contra-indicated, as frequently happens in chronic bronchitis, I can confidently recommend that their place be supplied by the preparation under consideration, certain that if the case be well chosen, the benefit will soon be apparent, and equally certain that no prejudicial results will follow its employment. In this respect it differs from the alkalis or their carbonates, the prolonged employment of these disordering the digestive and assimilative functions, and ultimately producing a condition similar to scurvy, the nutrition of the body generally becoming impaired. It is very different with the chloride, its long-continued use never giving rise to symptoms of general cachexia. The testimony of many observers agree in this.

The efficiency of ammonium salt, as a remedy in the cases noted, led me gradually to extend its use, and subsequent trials, frequently repeated, have shown that in cases of chronic rheumatism it often proves of great advantage. It is doubtless true that we shall be occasionally disappointed. This, however, happens often with our best remedies; but in those forms of rheumatic disease in which there is but little constitutional disturbance—those cases, in short, in which the iodide of potassium is found advantageous—the chloride may be given with every likelihood of benefit. In this affection, I have given the salt a very extended trial; but, in recommending its use, I need scarcely hint that it is not to be depended on to the exclusion of those secondary means—warmth, frictions, &c., that form a part of any treatment we may employ. I have also tried the chloride in periosteal inflammation of a chronic character, and having a syphilitic origin. Here its advantages are not so apparent, yet it seldom fails to give relief, and in cases where the iodide of potassium has ceased to exert any apparent influence on the disease, the substitution of the chloride has been followed by a rapid cure.

In enlargement of lymphatic glands, I have not had such an experience of the use of the chloride as enables me to speak with confidence of its action. Yet more or less benefit will follow its prolonged employment. In that variety of bubo aptly designated Indolent, which so often exhausts all ordinary remedies, and frequently our patience, the use of the chloride often speedily effects its removal. I am in the habit here of applying it also externally. A strong solution being employed (3ii. to the 3i.), lint is soaked in this, applied to the swollen surface, and covered with oiled silk. In such cases, the general treatment must not be forgotten. The state of the bowels must be watched, and, if need be, corrected, the diet employed being nutritious. Carefully-applied pressure over the swelling is also a valuable auxiliary.

In another point of view, the chloride of ammonium has an advantage. It is cheap. This precludes the likelihood of intentional adulteration. Sometimes it is impregnated with iron, and, it is said, occasionally with lead. As regards the former, when present, it exists in such small quantity that it can in no way interfere with its action; and as regards the latter, any samples I have tested showed no evidence of its presence.

By writers on the *Materia Medica*, the dose of the chloride is stated

to be from 5 to 30 grains. The quantity prescribed by me has varied from 5 to 10 grains, three or four times a day. Dr. Ebdén, in the paper already noticed, states he employs from 25 to 35 grains in neuralgic affections, repeated at short intervals. I have never given the salt in such doses. His experience, however, accords with my own as to the effect on the system of the quantities I am in the habit of administering. This agreement was to me the more gratifying, as I was not aware of the existence of his paper till these remarks were nearly completed, and it adds to the confidence I have in urging the medicine on professional attention.

The chloride of ammonium may be administered in simple or medicated waters. Where there is evidence of febrile disturbance, small doses of emetic tartar may be advantageously added. I frequently prescribe it with some bitter infusion, as quassia, cascarilla, gentian, &c. In cases where an anodyne may be necessary, the solution of the muriate of morphia may be conjoined in appropriate doses. It need scarcely be added, that the alkalies with their carbonates, as also the nitric and sulphuric acids, are incompatible.

The preceding observations have been limited to a mere narrative of observed results. Any endeavor to explain the nature of the influence exercised by the chloride over the organism has been carefully avoided. To judge of the action or effect of a medicine is always sufficiently difficult, without attempting to accomplish more. Even where the mind is least biassed, the accidental is often apt to be confounded with the essential, and antecedents linked with results with which they may be but very remotely related. This is not to be wondered at when we think on the varied influences that combine to modify disease, and, as a necessary sequence, the actions of those agents we employ for its removal. Of disease we know nothing other than what is made known by symptoms and observed structural change, and of medicines only so much as they alter or modify these. Frequently the mind is not content with this, seeking to penetrate further, leaving the true field of observation, and attempting to grasp at what is placed far beyond mental reach. Thus is it that the science of therapeutics has not advanced with that steady onward step which has marked the progress of other departments of knowledge. The properties of matter are studied, the circumstances that modify these observed, and the information so acquired is applied to the purposes of life. The day is past in which it was sought to elicit its ultimate nature or essence. So ought it to be with medicines. Their actions, and the circumstances that modify these, should alone be investigated. The therapeutic power of the mercurial compounds is acknowledged, and every day applied in the treatment of disease; yet how little, how very little, of useful knowledge is to be gleaned by the study of the various hypotheses that have been offered to explain their action.

These remarks may be considered by some foreign to the subject of this paper. They will, however, serve to show why I have not thought fit to attempt to explain the *modus operandi* of the chloride.

Of this I know nothing. I have seen its beneficial employment, and presume to think that when in more general use, it will be assigned a position amongst our more valuable alterative, resolvent, and liquefacient remedies.

The following cases are appended in illustration of the effects of the salt. Numerous others might easily have been added :—

Jan. 25, 1855.—J. W., hawker, aged 45.—Has suffered from winter cough for many years. Four days ago was much exposed to wet, and has since been unable to leave his bed. When seen, skin hot, tongue furred, urine scanty, and bowels constipated. Pulse 120. Severe cough; scanty expectoration, and complains much of a feeling of constriction of chest. The stethoscope afforded the physical signs usual in bronchitis. Ordered him to be purged, afterwards to have tart. antimon. et potassæ, in nauseating doses, and a mustard poultice to chest.

Feb. 2nd.—Feverish symptoms gone. Cough still very severe. Complains of great difficulty of getting up the expectoration, which is so tenacious that he has to withdraw it from the mouth by the fingers. Ordered a teaspoonful of the following mixture, four times a day, in water :—

R Chloridii Ammonii	.	.	.	.	3ij.
Sol. Mur. Morph.	.	.	.	.	3iiss.
Syr. Simplicis	.	.	.	.	3vj.
Aq. Puræ	.	.	.	.	3iv. Solve.

Within twenty-four hours a marked improvement began, which continued till the expectoration acquired an almost watery consistency. Ten days after he was in his ordinary health.

August 15, 1855.—Mrs. G., aged 66.—Has been complaining of cough for some weeks, with slight difficulty of breathing. Is able to move about for the greater part of the day, but complains of weakness and pain, referred to anterior and lower part of chest. Pulse 70. Expectoration scanty and tenacious. Bowels had been freely purged before I saw her. Dry mucous rales heard over upper part of chest. Ordered the foregoing mixture, without the solution of the muriate of morphia.

27th.—Has still a little cough. Sputa come up freely. Is gaining strength. Has now no pain in chest, and the appetite is much improved.

July 1, 1855.—Mrs. —, married, and has had four children. Contracted syphilis, six months ago, from her husband. Was mercurialised at the time by a surgeon in the country, and used afterwards, so far as I could learn, iodide of potassium. She came under my care suffering from constitutional disease, manifesting itself on the skin, with sore throat and severe pain in the limbs. Her appearance was extremely unhealthy. Appetite nearly gone. Bowels disordered.

After touching the throat with the nitrate of silver, and attending to the bowels, she was ordered to sponge the body, night and morning,

with a tepid saturated solution of common salt, and to have a tea-spoonful of the following mixture three times a day :—

R Chloridii Ammonii	.	.	.	.	℥iiss.
Acid. Hydro-Chlor., dil.	.	.	.	.	℥iiss.
Aq. Puræ	.	.	.	.	℥ivss. Solve.

Shortly after beginning the medicine she began to improve, and at the end of four weeks all the symptoms had nearly disappeared.

Glasgow Medical Journal.

ACTION of STRYCHNIA on the HORSE.

To a horse set apart for experimental purposes, and laboring under no visible affection, but aged, strychnia was given in gradually increased doses, until 5 grs. were administered daily. No apparent effects following its exhibition, four hours after the same quantity was repeated, yet was no action manifested. On the next day the agent was again administered in the same doses, and some hours subsequently not the least alteration in the pulse had taken place, nor did the animal show any unfavorable symptom whatever. With avidity he watched for food, which he had been kept from during the day, being only allowed a little water. He was accordingly allowed his usual quantity of hay and water, and bedded up for the night. At 10 p.m., six hours after the last dose, he was found lying down, and in great pain, striking his belly with his hind legs, breathing laboriously, the circulation increased from 42 to 60 beats in the minute; tetanic spasms were present, and the animal started when touched, however gently. Bloodletting was resorted to, an enema thrown up, and the animal becoming more tranquil, other remedial means were abstained from. On the morning of the next day he was still lying down, and in great pain, and the pulse more accelerated. Blood was again abstracted from the jugular, and the clysters repeated. One hour after, the pulse had risen to 96, and it ultimately rose to 120. Hot fomentations were directed to be applied to the abdomen by means of rugs dipped in boiling water and wrung out. Pain greater, belly tympanitic, and yet the animal has eaten some hay, but refuses water. Another hour subsequent to this the pulse had fallen to 80, and from that it became reduced to 70, but the swelling of the belly had increased, and the animal still expressed great pain. All at once he experienced a violent convulsive paroxysm, and died instantly.

Inspectio cadaveris presented the lungs in a high state of inflammation; the stomach filled with food, indeed gorged; the intestines distended with flatus, and containing much fecal matter, mixed with a considerable quantity of gravel: the mucous lining of both the stomach and intestines exhibited a slight inflammatory blush, as did the cellular tissue throughout the body, but the brain and spinal marrow were unfortunately not examined. This omission was soon after supplied, for to a horse laboring under paralysis of the hind extremities, this

alkaloid had been given in gradually augmented quantities, till the dose reached 3 grs. twice in the day; and seven days after, not any beneficial effects having taken place the dose was increased to 4 grs. and ultimately to 5 grs. twice in the day, when the animal was destroyed, as no hope of cure was entertained.

Another opportunity was thus afforded for a post-mortem examination. The viscera both of the chest and the abdomen were in this case found in a perfectly healthy state. The membranes covering the brain and spinal cord, particularly the pia-mater, were highly injected, although the substance of the brain and spinal cord was healthy.

The cause of the paralysis was found to be the existence of small osseous tumors that pressed on the spinal sheath, associated with ankylosis of several of the vertebræ.

Veterinarian.

On a NEW ACARUS of the HORSE capable of TRANSMITTING the ITCH of that ANIMAL to MAN.

By MM. BOURGUIGNON and DELAFOND.

HITHERTO, the cases of transmission of the itch of horses to man has been involved in doubt. Seeing that the known parasite of the itch of horses could not live on the human species, and that the authors, who have expressed themselves in the affirmative, have never demonstrated scientifically that the malady transmitted was really due to the presence of an acarus proceeding from the horse. Starting from the data furnished by entomology, we were warranted in denying to the known parasites peculiar to the herbivora, and to the horse in particular, the faculty of transmitting the itch. Observation has just enabled us to trace effects to their causes, and to explain everything.

The horse may have two kinds of itch: the first of which is due to the presence of the acarian parasite proper to herbivora, and long known, which cannot trace furrows, live on the skin of man, or transmit the contagion to him; the second, due to the presence of an acarus identical with that of carnivora capable of tracing furrows, of transmitting psora, and of which no one has hitherto suspected the existence. This transmissible disease is as different in the whole of its symptoms from that which cannot be communicated as the parasites which cause them to differ from each other.

Comptes Rendus, No. 5, Feb. 1856.

On POISONING by the VAPORS of ESSENCE of TURPENTINE.

By M. MARCHAL DE CALVI.

A CASE of poisoning by the vapors of essence of turpentine occurred in a woman who for several days had inhabited a newly painted room.

The first symptom consisted in colics ; but very soon the most alarming symptoms supervened ; the patient became prostrated, the face deadly pale, black round the eyes, the eyes sunken, the lips scarcely moveable, the breath cold, no voice, the limbs cold and stiff, the pulse almost imperceptible and slow, the sight weak and troubled ; the intellect was unimpaired, and the patient felt as if about to die. The energetic use of stimulants, *inter et extra*, revived her, and after some relapses, which were immediately repressed, she recovered, but only at the expiration of a month.

The poisoning was unquestionable ; but what was the poison ? Was it the white-lead, or the turpentine ?

A first series of experiments made by me, in conformity with others previously instituted by M. Mialhe, go to prove that white-lead is fixed in the paint of which it forms the basis, and that, consequently, the symptoms produced by fresh paint cannot be attributed to it. Other experiments of my own prove that the vapors of turpentine produce poisonous effects on animals and man.

My Memoir also contains general remarks in which, after having related various cases of poisoning by the vapors of turpentine, I endeavor to ascertain the mode in which these vapors act on the system ; I regard it as a hypothenisant poison, and I am led to recommend the stimulant treatment, against the symptoms which it may produce.

The conclusions of my Memoir are :—

1. Ceruse is fixed in the paint of which it forms the basis, and has nothing to do with the symptoms which may arise from living in a freshly painted room.
2. These symptoms are due to vapors of turpentine.
3. The danger is the same in a newly painted room, whatever may be the compound, white-lead, or white zinc, which forms the basis of the paint.
4. There is danger of poisoning with turpentine so long as the paint is not perfectly dry, and the safest way is not to inhabit a room until all the odor of the essence of turpentine has disappeared.
5. Poisoning by turpentine enters into the same category as poisoning by the emanations of flowers.
6. The emanations of flowers act in two ways on the system ; idiosyncratically or as poisons.
7. The mode in which vapors of turpentine act, consist in a more or less profound hyposthenisation.
8. Stimulant treatment energetically administered, is that which is advisable in this poison. It is necessary not to neglect to excite peristaltic action of the intestine by appropriate means.
9. These last two conclusions are not absolute, since they are founded on only one fact.

Comptes Rendus, No. 24, Dec. 10th, 1855.

PHARMACY, &c.

On SWEET SPIRIT of NITRE.

By D. R. BROWN, of J. F. MACFARLAN & Co.

Mr. MACFARLAN, in the conclusion of his paper on Methylated Spirits, read at last meeting, intimated an intention of submitting some remarks on sweet spirit of nitre prepared from that spirit. The experiments, however, not being completed, some important and rather difficult questions remaining to be answered, I propose reading a short paper on Sp. Æth. Nit. from ordinary rectified spirit; believing it to be a necessary preliminary to any remarks upon its production from methylated spirit. I may, however, here say that we have found no difficulty in preparing a sweet nitre from methylated spirit, and offer for your inspection a sample nearly of the strength of the Edinburgh Pharmacopœia, and which in a dose of three drachms was found to act no otherwise than the ordinary preparation.

It appears that sweet spirit of nitre was known so early as the 13th century. It is at least something in its favor, that after six hundred years it still maintains its ground, and is in very general use.

An immense number of formulæ have been given for its preparation; but, however prepared, it consists essentially of impure hyponitrous ether and rectified spirit, in variable proportions; and these proportions vary from twenty per cent. of the ether down to one or even less. These variations are not indeed permitted by the Colleges of London, Edinburgh, or Dublin, each having for itself a formula for the preparation, and also a standard strength; yet each College differs from all the others. The Edinburgh formula gives a preparation containing 20 per cent. of hyponitrous ether, while that of the Dublin is only 8·70 per cent. With respect to the London formula it is difficult to say what its per-centage may be. The most extravagant calculation will afford no more than 16·43 per cent., while the reality is undoubtedly much below this amount. We have examined samples of what was termed "the best," and been unable by fractional distillation to find more than a mere trace; among these were samples from London. It is upon the presence of the ether that the virtues of the sweet spirit of nitre depend. It is surely a sad condition of affairs when a prescription, written and prepared in London or Dublin, shall, when taken to Edinburgh, have the dose increased to two doses and a half; or, that when written in Edinburgh and prepared in London or Dublin, the dose shall go down to less than one-half. But more sad still, that, the dose being either 20, 10, or 8·70 per cent. of the ether ordered, it should in reality contain only one per cent. It is surely time that variations in medical preparations were done away with—over the earth if possible—but at all events, at home; and more especially such variations as have been pointed out. We have long felt the necessity of calling the attention of the Society to this preparation. The permission by the Government to employ methylated spirit in manufactures gives us the opportunity.

All the formulæ, however numerous, given for the preparation of Sp. Eth. Nit., arrange themselves under one or other of three modes, having for their result a mixture of hyponitrous ether and strong alcohol, and are but modifications of one and the same process—namely, the production of hyponitrous acid by the action of nitric acid upon an excess of alcohol. NO^5 is made to act upon alcohol indirectly or directly. Either the NO^5 is eliminated from a salt containing it while in contact with strong alcohol, or the acid first freed from combination is added to the alcohol. The third mode is, first, the preparation of hyponitrous ether, and then its solution in rectified spirit. The second of these modes is that followed by the London Pharmacopœia, and the third, that by the Edinburgh and Dublin.

The action of NO^5 upon alcohol ought to receive an investigation such as, so far as we know, it has not hitherto met with; for although the number of products formed and separated are numerous, yet the precise conditions which give origin to these are not sufficiently defined; a few degrees more or less of heat, or an acid more or less strong, modify the results. But we confess the investigation to be most difficult. What we have to do with at present is the result of the action of NO^5 upon rectified spirit, as it offers itself to us in the preparation of the Sp. Eth. Nit. of the Pharmacopœias. The products of that action divide themselves into three groups, one of which passes off in the state of gases; another abides in the flask or retort; and the third, that with which we have to deal, passes over into the receiver. According to the London formula, we will have the in receiver a finished product, requiring no more to be done to it, consisting of a solution of impure hyponitrous ether, containing aldehyde, in a very strong rectified spirit. By the Edinburgh and Dublin formulæ we have a product which has yet to undergo purification, and afterwards to be mixed with its proper proportion of rectified spirit. But that purification does not give a chemically pure $\text{AeO} + \text{NO}^3$; it also contains aldehyde. The product by the formulæ of all the Colleges is then alike in this—they all contain $\text{AeO} + \text{NO}^3$, alcohol, and aldehyde, or the hydrated oxide of acetylene ($\text{C}^4 \text{H}^3 \text{O} + \text{HO}$).

Pure hyponitrous ether—or, in chemical language, the hyponitrite of the oxide of ethylene ($\text{C}^4 \text{H}^5 \text{O} + \text{NO}^3$), would require to be somewhat better known than it is.

Liebig, as quoted in

Turner, gives its density at 60° as 947 and boiling point 62°

Prof. Christison, that

prepared by the Edinburgh

process

Meissner, as quoted by

Prof. Christison

The late Dr. Pereira

Dumas

Regnault

.	“	“	899	“	70°
.	“	“	909	no boiling point	
.	“	40°	886	boiling point	70°
.	“	“	886	no boiling point	
.	“	No temp.	886	boiling point	69°·8

He also says that “pure nitrous ether is colorless;” of this we have met with no specimen.

Mitscherlich gives it also				
as "colorless" .	density at 46°	as 886	and boiling point	80°
The Dublin Pharm. .	" 60°	900	no boiling point	
The late Prof. Duncan,				
of Edinburgh, states				
when simply washed				
with HO, its . . .	"	No temp.	912	no boiling point
And after removing acid				
by KO	"	"	896	"
And when re-distilled .	"	"	866	"
We have thrice prepared				
it by Liebig's method,				
and the product was .	"	60°	900	boil. point 62°-64°

It is quite manifest that the densities and boiling points given cannot belong to one and the same fluid; nor can it be seen how the admixture of aldehyde of D. 790 at 65° and boiling at 70° can reconcile them. May it not be that $\text{AeO} + \text{NO}^5$ is formed, in some cases, as well as $\text{AeO} + \text{NO}^3$? Both its D. (1.112) and B. p. (185°) are high.

We have very often prepared the $\text{AeO} + \text{NO}^3$ of the Edinburgh Ph., and have frequently been unable to bring up the D. to 899 by solution $\text{Ca} + \text{Cl}$ or washing. Weak solution of ammonia, however, we find to answer the purpose, and we are no longer annoyed by a density ranging from 886 upwards; from 899—900 is now easily arrived at.

It may be instructive to state the result of the re-distillation of the product got by Liebig's method. When procured its boiling point was 62—4, and D. 900 at 60°. On re-distilling it, one-half had come over, and the thermometer stood at 66°; the D. of this first portion was 899—900 at 60°, and its B. p. 62°—64°. The temperature quickly rose in the distilling flask to 70°—72°, and a considerable quantity came over, the D. and B. p. of which were precisely the same as the first portion. The last portion came over between 72°—80°. Its D. was 900 at 58°, and its B. p. 62°—64°. Yellow vapors appeared in the distilling flask, and the small quantity of fluid left was strongly acid. Contrary to the indications of the thermometer, we find but one fluid partially decomposed in boiling.

In order to compare the formulæ of the different Pharmacopœias, and to do so fairly, the alcohol and NO^5 made use of by each has been reduced by calculation to dry alcohol and dry NO^5 , taking for data for these calculations the table of Gay Lussac, as given in Prof. Christison's *Dispensatory*, for the alcohol, and Ure's table for NO^5 in Turner. The products also have been dealt with in the same way, and the loss of alcohol in each process found.

The following short tables will best tell their own story:—

	MATERIALS USED.		THE PRODUCT CONTAINS	
	Dry Alcohol.	Dry NO^5	Dry Alcohol.	$\text{AeO} + \text{NO}^3$
London	28.143	2.982	17.356	4.140
Edinburgh	32.547	8.368	21.93	6.975
Dublin	33.771	3.586	29.54	3.600

Of dry alcohol, allowing for the hyponitrous ether, the loss in each process is :—

London	28.143	less found in product	19.859	=	Loss	8.248
Edinburgh	32.547	"	"	26.208	=	" 6.339
Dublin	33.771	"	"	31.757	=	" 2.014

The per-centage loss is—London, 29.3 ; Edinburgh, 19.47 ; Dublin, 5.96. Taking the strongest, the Edinburgh, as the standard $28.905 = 6.975$ of $\text{AeO} + \text{NO}^3$, then 5.58 instead of 4.140 ought to be contained in the London, and 7.99 instead of 3.6 in the Dublin.

The above numbers refer to weight and to dry alcohol and dry $\text{AeO} + \text{NO}^3$; but we have to deal with the bulk and with water therein, when Sp. Eth. Nit. is dispensed.

The bulk product of the

London is	28	fluid ounces, containing	4.60	of dry	$\text{AeO} + \text{NO}^3$
Edinburgh,	38.75	"	"	7.75	"
Dublin	46.00	"	"	4.00	"

and the medicinal value of these is by bulk—London, 16.43 ; Dublin, 8.7 ; and Edinburgh, 20 per cent. of $\text{AeO} + \text{NO}^3$. Difference of density, which would make a slight alteration, has not been taken into account here, and with regard to these calculations, there can be no doubt as to the Edinburgh and Dublin results. The London, however, have gone on the extravagant supposition that the whole NO^5 is converted into NO^3 , and united with its equivalent of AeO , which is most unquestionably not the case. They are also based upon the supposition that the alcohol in the London product is of sp. gr. .825. The impossibility of finding any indisputable data rendered these necessary.

Without doubt the Edinburgh process, as modified by the Dublin College, is the best.* It is the easiest, the safest, and most productive; and it possesses this prime qualification—its results are defined and definite. There is no dubiety as to the quality or strength of the product. Its composition is fixed, and it can only vary by internal change or intentional admixture. It undergoes both of these, the first rendering the second absolutely necessary. The Sp. Eth. Nit. of the Edinburgh Pharmacopœia changes very rapidly. In a very few days after its preparation, a large amount of free acid is found to exist in it, which goes on increasing; and its removal must be accomplished before the sweet nitre can be dispensed, unless all parties are regardless of the chemical constitution of what is prescribed. As an instance, let us suppose a very common case. That a prescription contains iodide of potassium and sweet spirit of nitre. If it is made up with the sweet spirit of nitre, almost universally found in use, no change, or a very small one, will take place upon the chemical constitution of the KI; but if made up with Sp. Eth. Nit. of the Edinburgh Pharmacopœia, which has been made but a short time—a week perhaps—then, instead

* The NO^5 ordered by the Edinburgh Pharmacopœia, is of D. 1500. which is an objection of more force than at first sight appears; for a pure acid of that of D. is scarcely to be found in the market. Dr. D. MacLagen, however, has shown, what is practically valuable, that an increased quantity of a weaker acid will answer the purpose perfectly.

of KI and a colorless fluid, we will have a deep brown liquid, containing $\text{KO}+\text{NO}^5$ and free iodine. But the Edinburgh preparation is not singular in undergoing this change. It takes place more or less in every sample we have met with, and, so far as we can judge, just in proportion to the amount of $\text{AeO}+\text{NO}^3$ in the preparation. The weaker it is, the better it keeps. Less acid is found in the fluid, just because less existed in it. It is to this proneness to change that we ascribe the almost universal departure from authority, both as to *modus operandi* and per-centage of ether, which has taken place. The Pharmaceutical Chemist *cannot make* sweet spirit of nitre in drachms or half-ounces every time he dispenses a prescription containing it. He must make or buy an article that will retain its properties for at least a reasonable time; and the manufacturing chemist cannot sell an article which spoils in a day or two, for no one will have it from him. Thus, both are compelled to hunt about for better processes, and not finding them, either to give up making or selling, as the case may be. Or else the Pharmaceutical Chemist buys and uses whatever is offered to him, asking no questions. We have met with no specimen which contained the full amount of $\text{AeO}+\text{NO}^3$, but we have met with it where it held internal evidence that at one time it had contained all it ought. And we have found in our own experience, that after some weeks, a sweet nitre, originally made according to the Edinburgh Pharmacopœia, with 20 per cent. of $\text{AeO}+\text{NO}^3$, was deficient to a considerable extent, eight per cent. having disappeared.

The change which occurs in sweet spirit of nitre has been long known, and many endeavors have been made to prepare it without this liability. Some, indeed, deny that this liability is inherent in the preparation, and among others, the late esteemed Pereira mentioned that he had some which had been in his possession for years, "and which possessed only slight acidity." It is to be regretted that the formulæ and original strength of these keeping sweet spirits of nitre are not given. It is also asserted that sweet spirit of nitre made with $\text{AeO}+\text{NO}^3$, made according to Liebig's process, keeps better than that made by the ordinary process. So far as our experience goes, this lost assertion is true; but the only vehicle we have found which will give a stable mixture is absolute alcohol—confirming Professor Christison's observation. It is obvious that the price of sweet spirit of nitre made with $\text{AeO}+\text{NO}^3$, procured by Liebig's process would tend to render its use very limited indeed. But whether it would or no, are we at liberty to follow that mode? We think not. We have already said that the product of the formulæ of all the Colleges contain with $\text{AeO}+\text{NO}^3$, and rectified spirit, aldehyde, or the hydrated oxide of acetylene ($\text{C}^4 \text{H}^3 \text{O}+\text{HO}$). It is known to be contained in the spirit of nitre of the Pharmacopœia. Are we then at liberty to remove that which though undoubtedly an impurity in $\text{AeO}+\text{NO}^3$, is yet an integral part of sweet spirit of nitre? There is some reason to believe that the presence of the aldehyde is the cause of the decomposition of Sp. Eth. Nit., but it may be, for ought we know, upon the presence of

the aldehyde that some of the medicinal value of that preparation depends, and, thus, the question remains, will its removal, while it improves the keeping qualities, not destroy its medicinal value?

With regard to the use of absolute alcohol as the solvent of the ether, there does not appear to be any other good objection than the difficulty and expense of procuring it; and that is though not insurmountable, yet a very serious objection.

But are these changes indeed absolutely necessary? A much weaker preparation has been in almost universal use for many years past, and not many complaints have been heard against it. The Edinburgh process is perfect in its details with, we think, one exception, namely, the use of milk of lime to neutralise the impure $\text{AeO} + \text{NO}^3$, sol. of ammonia, ordered by the Dublin formula, as already mentioned, having been found to answer better. But the proportion of $\text{AeO} + \text{NO}^3$ is too great to give a fluid that will keep. In fine, we believe that, were the standard of all the Colleges made 10 per cent., all the difficulties would be overcome. Such a preparation would keep a reasonable time, and be produced at a moderate price. It would give a spirit which would answer every purpose, and leave without an excuse any attempt at the production of a weaker, which will not be the case so long as conditions are laid upon the manufacturer which he finds it impossible to fulfil. The present formula tells him to make and mix 20 per cent. of hyponitrous ether with 80 per cent. of rectified spirit; it is so clear and excellent in its directions that neither doubt nor difficulty meets the operator—he can most easily comply with the demands of the formula. But he has those who supply the public to meet with, and they demand from him, and not unreasonably, that he shall supply them with a spirit of nitre which will hold its integrity for a longer time than a week or ten days; and he can comply with this demand also. But he cannot conjoin the demands of the formula and the consumer—one or other must give way. It is surely bad policy to give the wrong-doer a good excuse for his malpractices. As it is at present, no honest manufacturer can advantageously enter into its preparation, for no one will make use of the genuine production. We have never been able to prepare a sweet spirit of nitre with 20 per cent. of the $\text{AeO} + \text{NO}^3$ of the Edinburgh Pharmacopœia that did not begin to decompose within a day. And when sent out our friends have found it both in respect of strength and free acid so totally unlike anything they had hitherto met with, that they refused to have anything to do with it.

Before leaving the spirit of nitre of the Edinburgh Pharmacopœia, we may say that while the tests given for its purity are perfectly accurate, they must be applied with a caution that the D. 847 may be given by the addition of water, and that the solution of CaCl be such as to contain about 40 per cent. of dry CaCl . It is to be observed, also, that the tests given are only applicable to a very recently prepared spirit. A sample made according to the Edinburgh Pharmacopœia on Jan. 7th, of D. 847 and which separated by half its bulk of

solution of CaCl, containing 40 per cent. of dry CaCl, 12 per cent. of $\text{AeO} + \text{NO}^3$, was tested on Jan. 17th with solution of CaCl of different strengths. The following are the results:—

Sol. CaCl containing 20 per cent. dry CaCl, sepd. of $\text{AeO} + \text{NO}^3$, 8.9 per cent.					
"	"	30	"	"	11. "
"	"	40	"	"	11.5 "
"	"	50	"	"	10. "
"	"	60	"	"	8. after two
hours in a 2nd experiment, 9 per cent.					

It has already been said that the examination of some specimens marked "the best," from London, gave scarcely a trace of $\text{AeO} + \text{NO}^3$. This ought not to be ascribed to adulteration, for experiment has shown us that it is not only possible, but really the fact, that nearly the whole product may be drawn over before the production of $\text{AeO} + \text{NO}^3$ commences. The late Dr. Golding Bird many years ago made some investigations into the nature of the products left in the retort after the preparation of spirit of nitre by the formula of the London Pharmacopœia. That which we would call your attention to in his results is the very large amount of hyponitrous ether found by him in that residue. He has not given the quantity found, but we are much mistaken if he does not give data for saying that by far the largest portion of the ether was left to be thrown away. This we suspect is the case still. In one experiment, where 14 fluid ounces were ordered to be drawn over, as being the amount of the product, nearly the whole came over before a trace of hyponitrous ether made its appearance.

We will give the details of an experiment made on Jan. 21st, 1856; 40 fluid ounces of alcohol, of D. .838, were mixed with $3\frac{1}{2}$ fluid ounces of pure NO^3 , of D. 1420 or thereby (it was found to be 1415 at 71°), and distilled. The quantity ordered to be distilled over is 28 fluid ounces. It boiled at 176° — 178° , and when the temperature had reached 182° , 21 fluid ounces had come over into the receiver. The D. of this portion was .834, and was alcohol without the very slightest taste or smell of nitrous ether. The next portion came over below 184° ; it measured 3 fluid ounces, and its D. was .837, and in other respects altogether like the first. The third portion measured about 4 fluid ounces; its D. was .840, and was not perceptibly different from fine spirit. The temperature had now reached 188° . The fourth portion measured 3 fluid ounces; its D. .845, and it was merely flavored with Sp. Eth. Nit. The temperature was now 192° . The fifth portion was $1\frac{1}{2}$ fluid ounces of D. .854, tasting distinctly of sweet nitre. Up till this period no other action could be perceived than ebullition. There was no escape of gas through the receiver. When, however, those $32\frac{1}{2}$ fluid ounces, or thereabout, had been distilled off, action began, the thermometer falling from 192° to 182° ; action was vigorous to 180° , where it remained for a short time, and on removing the gas-burner it fell gradually to 168° , and all action was nearly at an end. The last portion amounted to $8\frac{1}{2}$ fluid ounces; its D. was .890; and when treated with half its bulk of solution of CaCl, containing 40 per cent. of dry CaCl, it separated 46 per cent. of ether, whether

the $\text{AeO} + \text{NO}^3$ of the Edinburgh Pharmacopœia was not examined into. The first, second, and third portions were mixed together, and gave faint indications of aldehyde, as did the fourth. With the fifth, alcoholic solution of KO gave distinct coloration; and with the sixth, the color was deep. We think this experiment bears out the remark that nearly the whole product may come over without a particle of $\text{AeO} + \text{NO}^3$.

Pharmaceutical Journal.

ON METHYLATED SPIRITS OF WINE.

WE know no valid objection to the methylated spirit of wine being used generally, by the members of our profession, in their pharmaceutical compounds.

The compound which is now sold under this name, at a price about one-third of that paid for rectified spirit of wine, consists of wood-naphtha, or pyroxylic spirit, added to spirit of wine, in the proportion of one part of the former to nine parts of the latter. The object which the government authorities have had in view, is to allow of the use of a fluid for scientific and chemical purposes free of duty, and at the same time, by admixture, to prevent its being resorted to for drinking purposes; so that the revenue may not be seriously affected by the act. This is both wise and liberal, and there is no doubt that the result will prove a boon to many manufacturers, and that many pharmaceutical compounds will be lessened in price by it. Already ether and collodion are made from it of excellent quality, and other compounds we may confidently hope will quickly follow.

It is now several years since, that the pyroxilic spirit alone was employed by us as a solvent for the gum-resins, and found to be an admirable topical application for wounds, abrasions, &c. Its use as an internal remedy has also been often suggested by us.

A disposition to group or classify substances seems to have obtained among chemists of late years. Among the compound substances so arranged, we find what are called the *ethyle* and *methyle* series, not here to speak of any others. These may be viewed as organic bases, or compound radicles, consisting of carbon and hydrogen, and by their combining with oxygen, chlorine, iodine, &c., they form a class of substances analogous to haloid salts.

Alcohol, or spirit of wine, belongs to the ethyle series; corresponding with which we have methyle series, to which pyroxilic spirit belongs.

Methyle is a compound of $\text{C}^2 \text{H}^3 = 15$. *Symbol, Me.* Its *oxide*, or, *methylic ether*, is obtained by the action of four parts Acid. Sulph., on one part pyroligenous spirit, aided by heat. The evolved gases are to be collected over mercury, and will be found to consist of the oxide of methyle, mixed with carbonic and sulphurous acids: these last are to be abstracted by potassa, or milk of lime.

Oxide of methyle is a colorless gas, of an ethereal odor, inflammable, burning with a pale, blue flame. Sp. gr. 1.59, and is not liquefied

at 0°. *Composition.* $C^2 H^3 O=23$, or Me. O. It is thus seen to be isomeric with alcohol, the difference being dependent upon the different densities of their hydro-carbon, the H, C, which form 1 atom of alcoholic hydro-carbon, forming 2 atoms of methylic hydro-carbon.

Pyroxilic alcohol, or *wood spirit*, *alcohol of wood*, or the *oxide of the hydrate of methyle*, $C^2 H^4 O^2=32$, or Me, O+HO=32, is the result of the distillation of wood in the formation of acetic acid. Of this compound a very variable portion passes over, not amounting on an average to more than 1 per cent. It has to be re-distilled and rectified over lime, when it occurs as a limpid liquid of a peculiar odor, resembling alcohol, and acetic ether. Taste, hot and pungent, something like strong peppermint; inflammable, burning with a pale flame; boils at 150°, and mixes in all proportions with water, ether, and rectified spirit. Sulphur and phosphorus are to a certain extent, soluble in it, and it dissolves the resins; hence, it may be used as a substitute for alcohol. It is a powerful antiseptic, and has been found an effective preservative of subjects for dissection. It may likewise be used as a therapeutic agent.

The only instance which we are acquainted with of pyroxilic spirit having been given internally, has been communicated to us in the following note:—

TO THE EDITOR OF THE "VETERINARIAN."

Towyn, near Machynlleth.

DEAR SIR.—Remembering your suggestion, when a pupil, of the desirability of giving a trial to pyroxilic spirit as an internal remedy, I have been induced to do so in two cases as follow:—

About a fortnight ago, a mare of ours, two years old, got into a ditch, and was there for some hours before she was taken out, when she was, as might be expected, very cold and stiff. I ordered her to be well cleaned, then hand-rubbed until dry, and afterwards to be warmly clothed. I then gave her $\frac{3}{4}$ ss of naphtha in warm gruel. In a few hours after, I went to see her, when I found her very warm, especially under the clothes, where, indeed, the skin felt damp, as if she had perspired; she also looked quite lively, and was eating. In a short time after, the skin was dry, and not so warm. I thought that the naphtha, here, had a diaphoretic effect; but it was impossible to speak positively, as she might have not been rubbed quite dry enough at first. Yesterday, another trial of the agent was made by me. A cream-colored two-year-old-colt was selected, which appeared to be in good health, and to which, at 9 o'clock a.m., naphtha, $\frac{3}{4}$ ij, were given him in warm water. As he was rather wild, perhaps, $\frac{3}{4}$ ss of the medicine was lost. The animal was then covered with warm rugs; but I could not ascertain his pulse, because he was so restless. At 10, the skin felt warm; but still his pulse I could not feel. At 12, I put my hand under the rug, when I felt the body quite damp; the pulse too, was then distinctly counted, beating 50 times in the minute. At 1 o'clock, he was much the same. At 3 o'clock, skin not so warm; pulse 50. He afterwards got cooler, and the pulse lower, until 7 o'clock, when it settled at 32.

It may be observed, that his appetite did not seem to be in the least affected by the medicine, for every time I saw him, he was eating his hay.

Now, can we call naphtha a stimulant and diaphoretic?

Be this as it may, I believe that it is a very good substitute for spirit of wine, especially for external applications, and especially in cooling lotions, &c., because it generates more cold by evaporating than agents of that class usually do.

I am, sir,

Yours very sincerely,

—*Veterinarian.*

GRUFFYDD J. EVANS.

ACTION of STRYCHNIA on the DOG.

JUNE 16th.—The sixteenth part of a grain was administered to a dog laboring under chorea.

19th.—Three days after, the dose was increased to one-eighth of a grain. About two hours afterwards a slight convulsive paroxysm took place, which soon, however, passed off.

20th.—Dose to be repeated.

21st.—No apparent effect having followed this dose, it was given twice in the day.

24th.—The dose being now one-eighth of a grain and given twice a day without any marked effect, for three days, it was increased to a quarter of a grain. Again, two hours after the exhibition of the agent, another and a more violent convulsive paroxysm took place. The prostration of strength was considerable, the animal being unable to stand, and the spasms of the muscles of the whole frame violent. In a short time, however, he was able to get on his legs, when his pulse was found to be 130; the respiration much labored; the saliva flowed freely from his mouth; the pupils were dilated; he started at the slightest noise being made, and evinced much fear. He was, however, only able to maintain the standing position by placing both hind and fore legs wide apart, while all power of locomotion was lost. These symptoms gradually disappeared, the animal, in four hours afterwards, being comparatively free from them.

25th.—The same dose was again administered, and nearly the same effects followed, but they were less powerful.

27th.—Two days were allowed to intervene, and as the disease appeared not to have yielded, a quarter of a grain of strychnia was again given. Scarcely any effects followed the exhibition of this dose. The following day it was given twice, and thus repeated daily, without any very marked action.

July 4th.—Two days had again elapsed without the medicine having been given, when it was exhibited in the same quantities as before, this being found as much as could with safety be administered; and although four doses had been consecutively given without any marked effect, yet the dose to-day produced violent action. The animal, two hours after its exhibition, suffered considerable prostration

of strength, lost all power of standing, and involuntarily voided the contents both of his rectum and bladder. The pulse and respiration became much accelerated; the saliva flowed from his mouth; the spasmodic twitchings of the body were most violent, and the other symptoms manifested were precisely analogous to those already recorded. Soon, however, the animal was enabled to rise, and by making, as it were, props of his extremities, he maintained the standing position, when the effects gradually became less and less urgent, and four hours afterwards the whole of the unfavorable symptoms had disappeared. The disease not having yielded, the use of the agent was discontinued.

Scattered throughout the pages of this Journal will be found accounts of the action of this powerful alkaloid on different animals. We may be permitted to refer our readers to vols. ix, xii, xiii, and xxiv.

Veterinarian.

On the PATHOLOGY of the PANCREAS.

By DR. EISENMANN.

THE interesting experiments of M. Cl. Bernard upon the uses of the pancreatic juice, have led the author of this article to consider, whether or not, the results obtained by that physiologist, are capable of being applied to the diagnosis of disease in this organ.

If the pancreatic juice assists the digestion, and consequently the absorption of fatty matters, the conclusion is, that when the functions of that gland are destroyed by disease, fat should pass with the dejections, and be found in them in an unaltered condition. It is interesting to observe, how nearly science has anticipated what the observations at the bedside of patients laboring under such disease have confirmed. The author has united the facts observed by others with those presented in a case of his own.

Of seven cases adduced, six terminated in death: there had been abundant fatty evacuations, and *post mortem* examination showed the existence of induration, or other alteration in the pancreas. In the seventh case, quoted from Lussana, the patient recovered. The principal symptoms in this case were copious salivation, a sense of weight in the epigastrium not increased upon pressure, eructations, flatulence, coldness of the surface, and a small and slow pulse. The expression indicated abdominal disease. Constipation was present, but the *faeces* contained yellowish particles resembling fatty concretions, and which were in fact composed of fatty materials. These occurred in increased quantity after purgatives. M. Eisenmann regards Lussana as the first who applied to pathology the discovery of Bernard. In the instance observed by himself, the author had diagnosed pancreatic disease, but had not made out the presence of fat in the evacuations. This circumstance induced him to suppose that the pancreatic juice did not exclusively produce the absorption of fatty matters, but was assisted in this action by the bile. Budge and Wistinghausen have made experiments which countenance this idea, and the author recalls a case cited by Pearson, of a woman who evacuated daily 3 ounces of a fatty substance, and did not present, upon *post mortem* examination, any

trace of pancreatic disease, but the liver was pale, large, and destitute of bile. One remarkable circumstance, is, that in many of the cases cited by M. Eisenmann, the oily evacuations had ceased, while the pancreas was so indurated as to render the performance of its functions impossible. The author also alludes to another circumstance, not less worthy of remark, viz., the large quantity of fat yielded, a quantity much greater than that contained in the food, and which leads to the supposition that part of the faecal matters is transformed into fat. However that may be, the fact shows us that the presence of fat in the intestinal evacuations, indicates with probability, but not with certainty, derangement in the functions of the pancreas; while, on the other hand, the absence of fatty matter does not authorise us to conclude that there is no disease in this gland, if other symptoms exist indicative of such an affection.

The author has endeavored to employ the facts collected by him in establishing a more correct symptomatology of disease of the pancreas. He divides the symptoms into two classes, those accompanying degeneration of the gland, and those arising from its acute or chronic inflammation. For the first of these, the symptoms are too various to afford any certain signs of the affection; the presence of fat in the evacuations, and the examination of the abdomen by the hand, suggest, but cannot positively determine, its presence. It is otherwise, according to the author, with inflammation of the pancreas. This is distinguished by a sense of weight in the epigastrium, which is especially manifest about two hours after eating, extending towards the breast with a feeling of oppression; loss of appetite, inodorous eructations, *malaise*, retching or even vomiting, although the tongue may remain clean; constipation; small diminished pulse; emaciation; expression of features indicative of an abdominal affection; melancholy and sometimes weariness of life.

The author recommends, as a mode of treatment, the waters of Friedrichs-hall, in small doses.

Ed. Med. Jour. from Vierteljahrschrift für die Praktische Heilkunde, 1853.

ERRATUM.

In Mr. Davy's article "On the Comparative Value of Peat and Peat-Charcoal for Agricultural Purposes," in our March No., p. 339, 5th line from bottom, *for* "electricity" *read* "elasticity."

"ANALYSIS OF BANK-NOTE SLAG."—Dr. Griffin regrets to find that he omitted to mention, in his paper on the above subject (p. 350), the following step in the analysis:—The main solution, after being reduced by boiling with sulphite of soda, and subsequently with caustic soda, gave a dense black precipitate (*aa*) and a filtrate (*bb*). The former was dissolved in hydrochloric acid, neutralised with ammonia, the metals precipitated by sulphide of ammonium, and the filtrate (containing much of the *lime* thrown down by the caustic soda, being always *carbonated*) added to (*bb*). The sulphides were then dissolved in nitro-hydrochloric acid, &c. &c.

THE CHEMIST.

ORIGINAL COMMUNICATIONS.

An ACCOUNT of some EXPERIMENTS made to DETERMINE the RELATIVE DEODORISING POWER of PEAT-CHARCOAL, PEAT and LIME.

By EDMUND DAVY, F.R.S., M.R.I.A., F.C.S.L., &c.

PROFESSOR OF AGRICULTURAL CHEMISTRY TO THE ROYAL DUBLIN SOCIETY.

(Abstract of a Paper read at one of the Scientific Meetings of the Royal Dublin Society.)

PEAT charcoal, like that from wood, has considerable deodorising properties, and has for some time been used for removing noxious odors. More recently *, I clearly ascertained that uncharred peat has similar properties, and it has since been largely used for sanitary purposes, and for making valuable manures from putrescent substances.

As I am not aware that any attempts have been made to ascertain the relative value of peat-charcoal and peat as deodorisers, I have made a number of experiments with a view to determine that point. The inquiry though little inviting, derived interest from the magnitude of our bogs, and their connexion with agriculture and the public health.

Before I entered on this investigation, it appeared to me to be very difficult, if not impracticable, to conduct it in an unexceptionable manner; but on consideration, it seemed obvious, that if the experiments were made on the same excreta, under similar circumstances, and with ordinary care, they might at least, afford approximations to accuracy, and lead to some useful results. To compare odors where the number and variety of them exceed all calculation, would be a matter of no small difficulty; but to decide upon such as are simply offensive or inoffensive, would be a much easier task. The conformation of the organs of sense in mankind, is so nearly alike, if not altogether the same; there would seem to be a standard in human nature, to enable us to form a just opinion of what is either offensive or otherwise, to the organs of smell. All that seems necessary to arrive at a tolerably correct judgment in a matter of this kind, is, that the organs be in a sound and healthy state, and not in a diseased or deranged condition. The opinion seems to be common and general, that the odor of animal excreta is at all times offensive; but that in certain stages of its changes, it becomes so intolerable, that persons of strong constitutions could not be exposed to its pernicious influence, even for a short time, without endangering their health, while it would inevitably induce disease in those of weaker constitutions: substances

* An essay on the use of peat or turf, &c.

which neutralise or destroy such foul odors, have been not inaptly called disinfectants.

The peat or turf I chiefly employed in my experiments, was taken from the Bog of Allen. I used it both in the state of turf mould, and in sods; it was under cover many months, and when exposed to a regulated heat for some time, it lost 14 per cent. of water, and yielded from 37 to 39 per cent. of charcoal, when heated sufficiently in close vessels:—

The peat charcoal I used was sometimes freshly made in the Laboratory, or brought from a store in Dublin, or recently left at the Society for sanitary purposes. All of it was dry, carefully kept in bottles, covered glass vessels, or in a box; none of it had been exposed to moisture or wet, which impairs its deodorising power.

All the experiments were extremely simple, and made on a very small scale, from an opinion that they would thus occupy less time, and afford equally near approximations to accuracy, as if made on larger quantities. To a constant quantity, namely, 125 grains of the mixed solid and fluid excreta, or night soil, in a small Berlin porcelain evaporating dish, the deodoriser was carefully added, and well mixed with a platina spatula, until the odor of the mixture was destroyed or rendered quite inoffensive.

The peat I employed, was in powder, and passed through a sieve having 340 apertures to the square inch; its deodorising power appeared to be doubled by long drying, when it lost 20 per cent. I found also, that by rapidly heating it for a few minutes, so as to induce a partial decomposition and a loss of 8 per cent., its deodorising power was much increased, and on heating it a second time, so as to incur a farther loss of 20 per cent., its deodorising power was increased in an extraordinary manner, which seems to be due to the production of creosote, or a substance analogous to it, when on the contrary, the heated peat lost less or more than 28 per cent., its deodorising power was much diminished.

The peat-charcoal I used was in a similar state of division as the peat, it was obtained from different sources as I have stated, but I found the differences in the deodorising properties of the several specimens, too inconsiderable to deserve special notice.

The lime was in fine powder when well burnt, and highly caustic; its deodorising power was more than double that of lime occasionally sent from the kiln; its deodorising power was diminished in some proportion to the quantity of water added to it. The night soil was taken from different receptacles at different times, and differed materially in its age, density, odor, &c., hence the very different quantities of the deodorisers necessary for the same weight of soil. Each comparative experiment, however, was made with similar materials, and under similar circumstances.

The deodorising properties of lime, peat-charcoal and peat appear to be due to chemical and not mechanical action, and are to a certain extent increased by minute division and intimate mixture; and though our knowledge of that action is defective, it is certain ammonia is

disengaged from night soil by lime and peat-charcoal, and the odor of creosote, or a similar substance, by dry peat.

I apply the term *deodoriser* to lime, peat-charcoal, and peat; because when they are severally mixed with faecal matter, the offensive odor of such matter is destroyed; but as that term is used in a different sense and applied to substances which appear to me to have no deodorising power, as sand and gravel, and these substances are compared as deodorisers, with lime and peat charcoal, it may be proper to make a few remarks on the subject. In a letter attributed to Dr. Sutherland late chief Sanitary Commissioner in the Crimea, addressed to Lord Shaftesbury and Sir James Clarke, which first appeared in the London Times, and was rapidly circulated in the press of the United Kingdom, dated Balaklava, July 19 last; Dr. S. says, "we use three deodorising substances, charcoal, lime, sand, or gravel; we have tried them all; peat charcoal acts extremely well, and in small quantity. It is therefore the best for certain purposes, as for instance, the deodorising in the trenches, and in the camp, where carriage is an object; damp or wet immediately destroys its qualities. Lime acts very well, and I think best when wet. Sand or gravel for certain purposes, is as good as either. A large quantity is required, and therefore its use is limited by carriage. We used it alone for the worst nuisances, namely, the horrible marsh at the head of the harbour. Six inches of sand spread over it entirely deodorised the soil."

Though sand or gravel may have been successfully used on a large scale for *covering* offensive matter in the Crimea, yet its action appears to be merely mechanical and temporary. Whereas, the action of such deodorisers as lime and peat-charcoal, is chemical and permanent. A mass of sand or gravel will not allow the odor of foul matter to pass through it, except such matter contain sufficient water to be drawn up through it by capillary attraction, when the odor will reappear. I found 5 grains of lime, readily and entirely deodorised a quantity of foul matter; while 3000 grains of sand or gravel merely diluted, but did not destroy the noxious odor of an equal quantity of that matter.

Again Dr. S. says "any of these substances *i. e.* charcoal, lime, sand, or gravel, would, I believe, act as disinfectants, if a proper quantity were used, or at least I presume so; but I suspect that bulk has more to do with disinfection than chemical composition. Peat-charcoal in any ordinary quantity is certainly not a disinfectant. It stops smells, and that is all. I may give you the following conclusive experiment:—The steamship Chester arrived here several weeks ago, laden with charcoal; she lay some weeks in the harbour, close to the wharf, and not far from large accumulations of foul matter, which had been covered up. She began to discharge her cargo in sacks, which were piled up close to her stern, so as to form a lofty wall, on the quay. The surface of the quay was covered with the charcoal dust, the same dust pervaded the ship and covered the men; so perfect was the deodorising effect, that there was no smell either in the ship or near it, although usually the air was very foul there. In two days, six cases of cholera appeared on board, of which five died. We sent the ship

outside at once. There were five subsequent cases of diarrhoea, but all recovered; a ship lying next to the Chester had no disease. The fact is certain and curious, and is confirmed, though not in so striking a manner, by all our experience here."

In reference to what Dr. S. considers as a conclusive experiment, proving that peat-charcoal is not a disinfectant, I may remark, that no reliance whatever can be placed on the mere contact of charcoal dust as a deodoriser of foul matter, its action at best, under such circumstances, is but temporary. The accidental falling of charcoal dust on foul matter, in the case referred to, can scarcely be called an experiment at all, much less a conclusive one on that point. In order to deodorise foul matter by charcoal dust or powder, not only contact, but intimate mixture, and a certain quantity of charcoal is indispensably necessary.

I have given a tabular view of the results of my experiments, which scarcely requires explanation. The first column contains the number of comparative experiments made. The numbers in the other columns express the exact quantity by weight of each substance named at the head of the column, required to deodorise 125 grains of night soil.

From five experiments it appears that the deodorising power of peat-charcoal is greater than that of peat, containing 14 per cent. of water, but, that the difference is not considerable. On the other hand, peat by a loss of 8 per cent. acquires a greater deodorising power than peat-charcoal, and when made to lose 28 per cent., its deodorising power appears to be about 5 times greater; that inferior lime has nearly 7 times the deodorising power of peat charcoal, and good lime fourteen times its deodorising power.

TABULAR VIEW of the Relative Deodorising Power of Peat Charcoal, Peat, and Lime, in different states, drawn from Comparative Experiments, made each on 125 Grains of Night Soil.

Number of Comparative Experiments	Dry Peat Charcoal.	Peat containing 14 per cent. of Water.	Peat Dry, lost 20 per cent.	Peat rapidly heated for a short time so as to undergo partial Decomposition, and a Loss of—							Caustic Lime.					
				8 per cent.	12½ per cent.	15½ per cent.	18 per cent.	21 per cent.	28 per cent.	33½ per cent.	41 per cent.	Dry, in Powder.	As a thick Paste, with Water.	As a thinner Paste, with Water.	As a Milky-like Fluid, with Water.	As Lime-water.
1	74	78	..	..	..	..	..	..	..	..	..	11				
2	74	81	..	..	..	..	..	..	..	..	..					
3	56	66	..	..	31	..	..	..	..	..	..					
4	71	81	..	..	..	..	..	..	14	..	..					
5	52	66	..	..	..	..	..	..	..	..	..					
6	51	74	37	..	..	..	..	..	..	..	..					
7	85	..	55	..	..	..	..	41	..	..	..					
8	80	..	55	..	..	50	47½	..	..	46	47½					
9	107	..	..	..	..	..	49	..	..	..	..					
10	71	..	..	50	..	..	..	..	15	..	..	5	17	45	97	853
11	70	..	..	40	..	..	..	..	14	..	..					
12	75	..	..	..	..	..	40	..	..	..	..					
13	70 6	..	..	..	..	..	32	..	..	..	..					
14	43	..	40	..	..	..	..	..	..	..	..					

On the ELECTRO-CHEMICAL DEPOSITION OF METALS.

By ALEXANDER WATT.

*(Continued from page 325.)*APPENDIX *continued.*

20. As electro-deposition takes place more rapidly upon those surfaces which are nearest to the anode, it will be necessary, in order to coat the article as uniformly as possible, to remove it occasionally, and to present a different surface of it to the anode. By doing this frequently, the article may receive a tolerably uniform deposit; or the anode may be shifted to effect the same result. Presuming that electro-deposition takes place principally where the article is in "electrical sight" with the anode, it is well to surround the work to be coated with surfaces of metal to be dissolved, which will save the necessity of frequently moving the articles in solution. The insides of teapots, &c., as they cannot be placed in the bath in such a position that the anode will be exactly opposite to the inner surfaces, should first receive a deposit inside, by filling the vessel with solution, and immersing a silver anode until the surface is sufficiently covered, when the teapot may be finished in the bath. If the solution is kept in motion, deposition will take place much more uniformly than if the solution be worked steadily; the deposit, however, in such a case, takes a longer time.

21. Stout copper wires conduct the current better than fine ones; consequently, the wire employed should always be sufficiently stout to carry the current freely. For a single cell of the battery described in a former paper (*see THE CHEMIST*, vol. ii., p. 462), wire 1-16th of an inch in thickness will answer well; whereas, if two or more cells are used, a thicker wire should be employed. If too thin a wire be used, when deposition is taking place the wire will be found to have become warm, and, in some cases, quite hot, owing to the wire being unable to carry the amount of current generated.

22. It is always advisable to commence the process of electro-deposition with moderate battery power; for, if too strong a current be employed, the solution will become decomposed, and the articles to be coated will receive the metallic deposit in such a form that it will not adhere to the surface of the article. The operation should be commenced with weak battery power, which may be augmented as the coating thickens.

23. Electro-deposition will proceed much quicker when the temperature of the atmosphere or of the solution is high; therefore, the operator should take care that the surface of anode exposed be not too great at first, or the battery power excessive, or the deposit will not be regular. Whenever a warm solution is employed, the deposit should be allowed to take place very gradually at first, by exposing a small surface of anode; the surface of anode may be increased as the coating becomes thicker.

24. Deposition from silver or gold solutions takes place more actively

upon brass, German silver, or copper, than upon silver or gold; therefore, the operation should be commenced slowly at first. When a copper or brass article becomes coated with silver, deposition does not proceed quite so rapidly as it did at first, when the inferior metal was exposed in the solution; therefore, the manipulator may accelerate the speed of the operation, as before described. The same observation applies to the operation of gilding. Gold is more easily deposited upon brass or copper than upon gold; therefore, after the first layer of gold has been deposited, the operation may be carried on more vigorously.

23. The apartment in which electro-deposition is carried on should be kept as dry as possible, and the temperature about 60°. In warm weather, when the apartment assumes a higher temperature, the strength of the battery power, &c., should be regulated accordingly, otherwise deposition may take place too rapidly, and be objectionable in its character.

24. The batteries employed in electro-deposition should always be made to work uniformly. When a battery works slowly, it is better to excite the positive element with fresh acid or salt and water, rather than to use an extra cell. The operator should carefully observe the rate at which deposition takes place with a battery; and, when he finds that the speed of the deposit becomes diminished, he should at once add fresh acid, until he finds the battery to work, as nearly as possible, at the same rate as it did when newly constructed. This may easily be done by noting down the rate of deposit of one cell per hour, and so on.

25. The zinc used in a battery, when it is to be acted upon with acid and water, instead of salt and water, should be amalgamated. This is accomplished by placing some mercury in a dish, with a little hydrochloric acid. A piece of flannel or baize, tied to the end of a stick and dipped into the acid and mercury, is to be rubbed all over the bar or cylinder of zinc, until it assumes the characteristic brightness of mercury. When a cylinder of zinc is to be amalgamated, I have found that putting mercury into a flannel bag, dipped now and then into hydrochloric acid, and applying it to the outside of the cylinder, renders the process of amalgamating this surface very simple, when only a small amount of mercury is at hand. This is a very economical method of amalgamating; as little or no waste of mercury occurs, with ordinary care.

26. When an amalgamated plate, bar, or cylinder, has been at work some time, the operator should ascertain if "local action" has taken place upon any portion of the metal. This may be done by first ascertaining if there be any effervescence in the cell. If local action has taken place, the zinc will give evidence of having been acted upon at certain parts, by a dull grey appearance of the metal at those parts. When this is the case, the zinc should be re-amalgamated, or, at all events, at those parts which have been attacked by the acid.

27. The copper cylinders or plates used in batteries should occasionally be dipped into nitrous acid for an instant, and then be plunged into cold water suddenly, in order to render them quite clear and free

from oxide ; in fact, when a battery is first constructed, it will work more vigorously if this process be applied.

30. As the copper conducting wires frequently become corroded, by being splashed with solution from the bath, or with acid, &c., from the batteries, I have frequently found that a slight coating of silver has protected the wires, and they have apparently given a better result in working.

31. In using binding screws, great care must be exercised, or the connection between the screw and the conducting wire may be very imperfect, and the current will be conveyed only partially, or not at all. I prefer, before fixing a binding screw, to slightly file the point of the screw, with a rather rough file, passed once or twice across, by which means the surface is roughened ; when the screw is turned, it cleans that part of the wire (if it be not already clean) on which it presses, and the connection is at once perfect. The hole through which the wire is to be passed, may be cleaned by means of a small round file. When binding screws become very much corroded, they may be pickled in dilute sulphuric acid for a few hours, and then cleaned with a hard brush and powdered pumice stone, or they may be dipped in nitrous acid.

32. Strips of copper will be found very convenient substitutes for copper conducting wires. The strips may be cut out of sheet copper, about 1-32nd of an inch in thickness.

33. In working a battery for the purpose of electro-deposition, the operator should take care that the quantity of the current be considerable, and that the intensity be only sufficient to give activity to that quantity. I prefer, when arranging two or more cells of a battery for electro-deposition, attaching the wires connected with the zincs to the metal rod on which the articles to be coated are suspended, and the wires proceeding from the copper cylinders of the battery, I attach to the anodes. By this arrangement, the quantity and intensity of each cell is multiplied by the number of cells employed ; whereas, if the cells are alternated, that is to say, the zinc of one cell is united to the copper of the next, and so on, the intensity is multiplied, and the arrangement only gives the quantity of one cell.

34. When it is desirable to deposit a metal in a *hard* state, it may be advantageous to alternate the cells, so as to increase the intensity of the current, as this quality seems to affect the nature of the deposit. A good tough reguline deposit appears to be dependent upon the current being of feeble intensity, but of considerable quantity. The quantity, however, may be rendered too great for the intensity, which will be objectionable.

35. A very useful form of battery, and one easily conducted, may be made with two large sheets of copper, fixed into a wooden frame, with an amalgamated plate of zinc between them, so adjusted that it may be readily raised or lowered into the cell, to suit the surface of articles to be coated by it. The cell may consist of a stone jar holding about 10 gallons. This jar is filled with dilute sulphuric acid, containing about 1 part of acid to 15 parts of water. The copper conducting

wires for this battery, should not be less than $\frac{1}{8}$ th of an inch in diameter—rather stouter wire being preferable. This form of battery has been much employed by electro-platers, &c. I prefer, however, a battery constructed with a zinc and copper cylinder, for I think much advantage arises from the elements being of a cylindrical form, instead of being in the form of flat plates.

36. For the electro-deposition of brass, I have generally found that a better deposit has been obtained, when two or more cells of a battery have been arranged in alternate pairs, for the zinc, being rather a difficult metal to deposit, appears to require a greater intensity of current than copper, and unless a considerable current be employed, the copper alone will be deposited. By employing too powerful a current, the zinc may be deposited only. The color of the brass may therefore be varied by variations in the power of the battery employed, more or less copper being thrown down with the zinc, according to the strength of the battery.

37. When electro-brassing, the operator should take care to avoid placing articles composed of different metals in the solution *at the same time*; for instance, one of iron and another of zinc, for, as these metals vary in their nature, the deposit will take place more readily upon one than the other, and in trying to make the deposit take place uniformly, the solution may be injured.

38. It is not advisable either, to put into the silver solution articles of different metals at the same time; but it is as well first to deposit a slight coating upon the one metal, then the other, and they may then be placed in the solution together without injury.

39. In gilding, if a copper and a silver article be immersed in the solution at the same time, the copper article will receive the deposit first, and the silver article will be very troublesome to gild sometimes, and in trying to force the gold on to the silver article, the gold will go on to the copper article so rapidly that it will probably strip off when the scratch-brush or burnisher are applied. As soon, however, as each article is coated separately, they may be placed in the solution together, if it be desired.

40. Each metal to be gilt, plated or brassed, should have a solution for itself, otherwise the solution in which several different metals have been coated, may become impaired, unless, however, each metal has previously been coated, to a certain extent, by itself.

41. When the anodes of gold, silver, or brass, after having been worked some time, appear very rough and full of holes, it is owing to a great excess of cyanide being in solution. When this is the case the anodes will crumble into pieces, and the numerous small particles which fall off the anode, will, if they are allowed to drop on the surface of the articles to be coated, cause a roughness of the surface, which it will be troublesome to remove. It will be as well, when this is the case, either to enclose the anodes in canvas bags or to put more metal in the bath.

42. When the anodes are only partially immersed in the solution, and have been at work for some time, the metal will dissolve off

rapidly at that surface which is just above the solution, and probably the anode may be divided, by this means, into two pieces. It is advisable, therefore, to occasionally alter the position of the anode in order to prevent this local action upon it. It is a good plan to suspend the anodes used in gilding, at all events, by means of strips of platinum, so that the whole of the anode may be immersed in the solution while gilding.

43. In the operation of gilding, sometimes the work will turn out of a very indifferent color, owing to an excess of cyanide being in solution, the gold having been worked out of it, or the presence of organic matter, or some other cause. It is useful, when such is the case, to have at command the means of giving a good color to work which is defective in this respect, without the trouble and annoyance of persevering with the gold solution. Some gilders employ the following mixture for this purpose, and it may be used when the work is gilt strongly, with advantage:—

Alum	3 ozs.
Nitrate of potassa	6 „
Sulphate of zinc	3 „
Common salt	3 „

Mix the above materials into the form of a thick paste, dip the articles or brush them over with this compound, and place them on a piece of sheet iron. The articles are to be subjected to the action of heat over a clear charcoal fire, until they appear nearly black, when they may be immediately thrown into cold water. A very useful mixture, and one which may be used with less fear than the above, especially for small articles, is the following:—

	oz.	dwt.	grs.
Sulphate of copper	0	2	0
French verdigris	0	4	12
Muriate of ammonia	0	4	0
Nitrate of potassa	0	4	0
Acetic acid	about	7	0 0

Reduce the sulphate of copper, muriate of ammonia, and nitrate of potassa to a powder in a mortar, then add the verdigris, and pour in, little by little, the acetic acid, stirring frequently, until the whole assumes the appearance of a thin blueish-green mass. The article to be colored is to be dipped into this mass, and, being placed upon a piece of sheet-copper, is to be exposed to the heat of clear fire until it assumes a black color. It is allowed to cool, and is then placed in a tolerably strong solution of sulphuric acid, which will dissolve the coloring salts, and the article will exhibit a rich fine gold color. It is sometimes advisable to scratch-brush articles to be colored by this process, previous to applying the coloring salts, and when the articles are colored they will come out of the sulphuric acid pickle perfectly bright. The articles, when removed from the pickle, may be rinsed, and placed in a solution of potash for a few moments. A brush and hot water, with a little soap, will much improve the appearance of the colored surface, especially if the work be chased or embossed.

44. The color of gilt work may sometimes be improved by moving it about in the solution, after gilding, without being in connection with battery. The improvement, however, principally applies to work which has become of a dark brown or *fox*y color in the solution. Motion of the articles while gilding will, at all times, enable the operator to vary the color of the deposit, from pale straw color to a very dark red. The temperature of the solution will also regulate the color of the deposit, the color being lightest when the solution is quite cold, and gradually becoming darker as the temperature increases. Variations in the amount of anode exposed to an article while being gilt, or of the distance between the anode and the article, will also affect the color of the deposit. The amount of cyanide in solution, and the strength of battery power, have also a great influence in this respect.

45. If there be not sufficient cyanide of potassium in the gold solution, the anode will not become freely dissolved; consequently, the gold which is deposited from the solution on the articles to be gilt will not be resupplied by the anode; in which case, the articles may gilt of an inferior color, and the solution become impaired. Adding more cyanide to the solution, under these circumstances, will not produce a favorable effect, as the gold will have been worked out of the solution. It will be necessary to add more gold to the solution.

LONDON, April 15, 1856.

(*To be continued.*)

TRANSLATIONS AND ABSTRACTS.

METALLURGY.

On ALUMINIUM. By the REV. J. BARLOW, M.A., F.R.S., V.P.,
Sec. R.I.,

MR. BARLOW commenced his discourse by presenting M. Sainte-Claire Deville to the Members of the Institution. M. Deville had travelled from Paris for the purpose of exhibiting specimens of aluminium, both unwrought and manufactured; and also assisting in experiments devised by him for illustrating the processes by which this remarkable metal is obtained.

Aluminium was discovered by Wöhler, in 1827.* But the means of producing this metal, to which that eminent philosopher was obliged to have recourse, were too costly to admit of its being employed in any practical use. Having succeeded in greatly diminishing this cost of production, and being supplied with funds by the liberality of the Emperor of the French, M. Deville has obtained this metal in an amount sufficient for scientific investigation, and for some important applications. †

* Ueber das Aluminium. Von F. Wöhler. Pogg. Ann. xi. 146.

† Recherches sur les Métaux. Par M. H. Sainte-Claire Deville. Annales de Chimie. Ser. 3. tom. xl. p. 21.

It was the object of the speaker, 1st, to cause that the difficulties attendant on the production of aluminium should be understood and appreciated; 2ndly, to describe its physical and chemical properties, and to mention uses which have been or can be made of it.

1st. For the purpose of illustrating the obstacles presented by nature to this last conquest of science, a comparison was made between the modes of producing—(a) *the metals of the early age*; (b) *of the middle age*; (c) *of the scientific age*, from their respective ores; and the means had recourse to for separating aluminium from its ore.

(a) Gold was taken as the type of the *ancient metals*. The common ore of gold is a mass of silica, to which this metal is found attached. Silica is a strong acid; but it cannot combine with gold. The two substances, therefore, being merely attached together by their mutual cohesion, can be detached by mechanical means. A comparison was made between this ore of gold and pure clay, the ore of aluminium. Clay consists of silica and alumina (the oxide of aluminium). In this substance, however, the silica combines as an acid, so as to form a natural salt, from which the alumina, and then the aluminium from the alumina, have to be successively separated, not by mechanical force, but by powerful chemical reagents. The ore of gold occurs rarely, but is recognised at once by any experienced eye; the ore of aluminium is one of the most abundant substances in nature, but its recognition as a metallic ore has tasked the extreme attainments of modern science.

(b) Iron, tin, antimony, and lead were next referred to as types of *the metals of the middle age*. Their ores were exhibited. The sapphire,* the purest form of corundum, which is native oxide of aluminium, was contrasted with hæmatite, the native sesquioxide of iron. The metallic aspect, characterising the ores of this class of metals, was noticed. This appearance must naturally have led to these substances being subjected to the action of fire. The separation of a metal by the reducing action of the fuel of the furnace on its ore, was illustrated by metallic lead, one of the ingredients of flint glass, being made visible by the action of the flame of a spirit lamp on a piece of that substance. Glass is a combination of silica with oxide of lead and other metals; it, therefore, carries on the analogy with pipe-clay, the silicate of alumina; but aluminium cannot be reduced from the silicate of alumina by any known fuel, at any known temperature. Were this not the case, crucibles, furnaces, even houses which are made of clay, would be decomposed, and the aluminium they contain extracted, whenever they were exposed to the force of a sufficiently intense combustion.

(c) *The metals of the scientific age*.—These metals were brought into visible existence by the pile of Volta. The searching and separating

* Miss Coutts, M.R.I., kindly lent three sapphires of great size and beauty to illustrate this discourse. It has been suggested that the characteristic color of these jewels may be due to the presence of a protoxide of aluminium (Al O).

properties of this wonderful invention were made known at the commencement of the present century. Simultaneously with this discovery there commenced the age of research, which began and is continued to this time in the Royal Institution. It is characterised by the historian of the "Inductive Sciences," as the epoch of Davy and of Faraday.* The knowledge and sagacity of Davy induced that distinguished man to seek for an *alkaligen* (or generator of alkali) at that (so called) pole of the voltaic battery, where Nicholson and Carlisle had recently found *hydrogen* (generator of water). This alkaligen was the metal of the alkali—the metal of the scientific age.

The speaker here adverted to the enormous difference which exists, not only between the alkaline metals and those of the former groups, but also between their respective ores. Neither the ore of potassium, nor (in Davy's time) the ore of sodium could be obtained directly from the soil through which its weak solution is diffused; it had to be sought in the tissues of plants which absorbed it from the ground. When obtained and concentrated, this substance is fusible, soluble, corrosive, and possessed of immense chemical power. The metal derived from this strange ore, though possessing lustre, ductility, malleability, power of conducting heat and electricity, differs in every other respect from every metal yet known. Its specific gravity is less than that of water, and its affinity for oxygen so great as to necessitate the invention of hitherto unknown expedients to prevent the metal from returning to its state of oxide, as soon as it was separated from it.

Davy seems to have accounted for the results he produced, by assuming that the poles of the battery acted as centres of force; that the potassium being repelled by one pole, was attracted by the other, like any light substance placed between two surfaces charged with opposite Franklinic electricity. Faraday† has taught that the whole of the subjected body is pervaded by this decomposing force as an axis of power, so that a particle in the middle is as much affected as a particle at the extremities of it; that, in order to be under the influence of this force, the body must be fluid, and a conductor of electricity, and that its elements must exist in a simple relation to each other, and that the proportional amount in which these elementary substances, separated by electrical decomposition, are severally ejected at the electrodes, (electrical outlets), corresponds exactly with that of their combining members. In accordance with these views, the voltaic pile may be regarded as a flameless furnace, whose reducing power is conveyed by the conducting wires to the spot where the ore is subjected to its influence. By these means not only the alkalies but the alkaline earths were decomposed, and their respective metals,

* Whewell's Hist. of Induct. Sciences, Vol. iii. p. 178.

† Experimental Researches in Electricity, Fifth Series. A perspicuous summary of the principles of this philosophy will be found in the history of the Inductive Sciences, ed. 1837, Vol. iii. p. 163, &c.; and Grove's Correlation of the Physical Forces, ed. 1855, p. 172, &c.

barium, calcium, strontium, and lithium, obtained.* But aluminium cannot be separated from alumina, its sesquioxide, by electrolysis. The metal does not in this case (as in those of potassa, lime, strontia, &c.,) combine with oxygen or any like body in single proportionals; and alumina, its only known oxide, is also infusible, except before the blow-pipe.

But although the voltaic battery be unable to separate aluminium from alumina, it has effectually aided in obtaining that metal. Not only was it the first source and sodium, substances indispensable to the production of aluminium, but in the subsequent preparation of those bodies, the philosophy of the pile has rendered essential service to chemists. Faraday has shown that electrical power is identical with chemical power. This being admitted, whatever the one power can effect, the other may be expected to accomplish. This consideration sanctions, if it does not suggest, the processes by which Gay Lussac, and Thénard, and Mitscherlich, and Brunner, and Donny, and Mareska,† and ultimately Deville, have obtained potassium and sodium (the latter metal especially), by direct chemical reaction; by a process so productive, that the melted sodium actually runs out in a continued stream, as in common distillation, from the iron retort, into a receptacle placed to receive it.‡

The powerful deodorising effect of the alkaline metals has been proved by its effecting not only the decomposition of carbonic acid gas, but also by the reduction of calcium, barium, and of silicium, a substance to which the attention of the audience was especially directed.

Clay had already been designated as a silicate of alumina: in fact, three-fourths by weight of a portion of pure clay are silica. Of this silica one half is oxygen, the other half silicium, a substance altogether new in its properties; it is not affected by water or by air, and it can be kept in either; it has no lustre, or any other resemblance to a metal; it is analogous to carbon.

Now, it is important to notice, that it was not from silica (the oxide), but from the fluoride and chloride of silicium that Berzelius obtained this substance. This fact, perhaps, instigated Wöhler's successful attempt to decompose the *chloride* of aluminium (a fusible and volatile substance) by the vapor of potassium, which has no effect on the oxide of aluminium. But the production of the chloride of aluminium demands a concentration of chemical power. The hydrated chloride, resulting from the solution of alumina in hydrochloric acid, on being evaporated, decomposes the last portions of the mother-liquor, and the

* M. Warren De la Rue exhibited specimens of lithium produced from the fused chloride by means of voltaic electricity. The negative pole was an iron wire; the positive, a piece of coke. Lithium is the lightest substance known.

† Recherches sur l'extraction du Potassium, par MM. J. Mareska et F. Donny, An. de Chem. Ser. 3, tom. xxxiv. p. 147.

‡ Recherches sur les Metaux, &c., An. de Chem. Ser. 3, tom. xliii. p. 19. M. Deville fused and cast above *half a pint* of sodium in a large ingot-mould to illustrate this part of his discourse. The present retail price of sodium in London is 4s. the ounce.

operation ends by the reproduction of alumina. This difficulty was surmounted by Cérsted; he caused the affinity of oxygen for carbon, and of aluminium for chlorine, to act simultaneously, and under the most favorable circumstances, by chlorine gas being led over an intimate mixture of alumina and charcoal heated to redness in a porcelain tube. The anhydrous chloride was thus evolved in vapor, and condensed in a suitable receiver. The apparatus contrived by M. Deville for procuring this substance, and described in the memoir already referred to,* was exhibited. Wöhler's process of obtaining aluminium from its chloride is well known. The following modification of that process, devised by M. Deville, was shown in action.

A tube of Bohemian glass, 36 inches long, and about 1 inch in diameter, was placed on an empty combustion-furnace, constructed for the purpose. Chloride of aluminium was introduced at one extremity of the tube; at the same extremity a current of dry hydrogen gas was made to enter the tube, and was sustained till the operation was finished. The chloride was now gently warmed by pieces of hot charcoal, in order to drive off any hydrochloric acid it might contain; porcelain boats, filled with sodium, were inserted into the opposite extremity of the tube; the heat was augmented by fresh pieces of glowing charcoal until the vapor of sodium decomposed that of the chloride of aluminium. Intense ignition usually attends this re-action. At length the aluminium was liberated in buttons, which were found in the boat adhering to a substance consisting of the mixed chlorides of aluminium and sodium. The boat was now transferred, with its contents, to a porcelain tube, through which hydrogen gas was passed. At a red heat, the double chloride distilled into a receiving vessel, attached to the tube for the purpose; the buttons of aluminium were collected, washed with water, and subsequently fused together under a flux consisting of the double chloride.

Another method of obtaining aluminium from the chloride has been adopted with success. It is as follows:—

4·200 grammes of the double chloride of aluminium and sodium (*i.e.*, 2·800 grammes chloride of aluminium, and 1·400 grammes common salt),

2·100 grammes of common salt,

2·100 grammes of cryolite,

thoroughly dry, and carefully mixed together, are to be laid in alternate layers, with 840 grammes of sodium (cut into small pieces), in a crucible lined with alumina—a layer of sodium should cover the bottom of the crucible. When the crucible is filled, a little powdered salt is to be sprinkled on its contents, and the crucible, fitted with a lid, is to be introduced into a furnace, heated to redness, and kept at that temperature until a reaction, whose occurrence and continuance is indicated by a peculiar and characteristic sound, shall have terminated. The contents of the crucible having been stirred with a porcelain rod, while in their liquified state—(this part of the operation

* *Recherches sur les Métaux, &c.*

is essential)—are poured out on a surface of baked clay, or any other suitable material—the flux, &c., on one side, and the metal on the other.*

In the experiment just described, the cryolite chiefly fulfils the office of a flux. But, twelve months since, Dr. Percy obtained aluminium directly from this mineral.† Cryolite is a fluoride of aluminium and of sodium. Dr. Percy found that layers of this substance, minutely pulverized, and heated with sodium in the manner described in the last experiment, yielded aluminium. Cryolite is found only in Greenland. A geological diagram of its locality, as well as some interesting specimens of the mineral itself, were exhibited by Mr. J. W. Tayler.‡

Such being the present known methods of producing this remarkable metal, the speaker adverted—

2nd. To the *properties of aluminium*. Its physical properties are very characteristic. Its specific gravity (2·25)§ is nearly that of glass, and consequently below that of any metal (with the exception of the alkaline metals, and the metals of the alkaline earths). It is malleable, ductile, and sonorous. Its fusing point is between that of silver and zinc; it resembles silver in its excellence as a conductor of electricity. Lastly, it has great capacity for heat—(about six times that of silver). But the chemical properties of this metal are such as could not have been conceived until ascertained by experiment. Instead of reassuming oxygen (like the alkaline or earthy metals) with an energy proportioned to its extreme tenacity of that element while in the state of oxide, aluminium appears to be as indifferent to oxygen as gold or platinum are. It is not affected by sulphur, like silver; nor is it acted on (except to a very slight degree) by any of the oxy-acids in the cold, its only solvent being hydrochloric acid. The strong affinity between this metal and oxygen before its separation, contrasted with the apparently total indifference afterwards, suggests the possibility that at the instant of its coming in contact with air, aluminium may receive a fine coating of oxide—a film of transparent sapphire—from the atmosphere, which protects it against the above-named corroding substances.

This conjecture is rendered plausible by the result obtained on exposing a leaf of aluminium to the oxidising flame of the blowpipe. The result of the combustion, though apparently a mass of alumina, shows by its metallic lustre, when rubbed in an agate mortar, that the oxygen has not penetrated below the surface; magnesium, on the contrary, whose oxide, like that of iron, separates immediately

* As time and space for fire operations in the theatre were limited, this experiment was not attempted during the discourse. But at an earlier period of the day, M. Sainte-Claire Deville had the honor of performing it, in the presence of H.R.H. Prince Albert, in the Laboratory of the Institution.

† Proceedings of the Royal Institution, Vol. ii. March 30, 1855, p. 79; Phil. Mag. Ser. 4. Vol. x. pp. 233 and 364; Comptes Rendus, Dec. 10, 1855, p. 1054.

‡ Lit. Gazette, No. 2039, p. 109.

§ The low specific gravity of aluminium, being nearly that of the flux employed in fusing it, enhances materially the difficulty of its production. M. Deville, however, melted together some pieces of pure aluminium without flux, and cast the fused mass in an ingot-mould before the audience.

on being formed, when similarly treated, burns away with intense ignition.

Alloys of aluminium may become important in the arts. The following, in the proportions given, were exhibited by Dr. Percy:—

Gold	} alloyed with 5 per cent. of aluminium.
Silver	
Tin	
Copper	
Lead	

In the gold alloy, the presence of the small proportion of aluminium was sufficient to convert the golden to a grey color.

The copper alloy was very interesting; it is malleable, and it "dips" of a fine golden color. A slip of this alloy seemed to have been little affected by a fortnight's exposure to the atmosphere of the laboratory. Should this substance be found, on further trial, capable of withstanding the corroding vapors of a London atmosphere, it might be used advantageously to make "tongues" for the "reed-pipes" of organs, as a material of clock-work, &c.

Dr. Percy also exhibited other alloys of aluminium, respectively, consisting of

Tin 90—Aluminium 10

Copper 90—Aluminium 5—Tin 5

Copper 93·7—Aluminium 4·5—Silicium 1·8

Copper 80—Aluminium 20

(In this alloy the characteristic color of copper was turned to white.)

Silver 80—Aluminium 20

(A hard and brittle alloy).

Solder of Aluminium.—Two parts of aluminium, and one of silver, will produce an aluminium solder without flux.

Uses of Aluminium.—Both the physical and the chemical properties of this metal are likely to ensure its application to many important uses, as soon as it can be supplied at a moderate price. (At present it is sold in England at £3 per ounce.)

M. Sainte-Claire Deville exhibited the beam of a balance, and weights, specially designed for the determination of small quantities, made of this metal, whose lightness peculiarly recommends it for such a purpose.

The same quality, as well as that of resisting corrosion, has been taken advantage of by the surgeon and the dentist. The sonorousness and ductility of aluminium have led to piano-forte wires being made of it; it may likewise be found useful in lining brass musical instruments, especially those having valves and slides. The property of resisting oxygen, sulphur, and acids, as well as its great power of retaining heat, render it highly valuable for culinary purposes. If, as may fairly be hoped, aluminium be hereafter produced at a rate that will bring it into competition with iron, it may supersede that

* Messrs. F. Crace Calvert and R. Johnson have made experiments on this subject.—Phil. Mag. Ser. 4, Vol. x. p. 244, &c.

metal in fabrics where lightness would, to a certain extent, compensate for inferiority of strength.

For example, the low specific gravity of aluminium, its freedom from all tendency to rust or tarnish, and its consequent power of reflecting the hot rays of the sun, indicate it as an appropriate material for the roofs of houses. As this metal is capable of plating iron, it would furnish a permanent and imperishable substitute for the paint now used for the protection of iron-railings, water-pipes, cisterns, &c., and which requires (what an aluminium surface would not) constant renewing.* The value of the oxide of aluminium in the ancient arts of life—pottery, dyeing, &c.—is notorious. It may not be visionary to expect that, before this century shall have closed, equally important services in augmenting the comforts of civilised life may be performed by the metal itself.

At the close of Mr. Barlow's discourse, Dr. Faraday briefly, but earnestly, expressed his sense of the obligations which M. Sainte-Claire Deville had conferred on the Royal Institution by his presence on that occasion, as well as by the time, intelligence, and trouble which he had devoted to make the members and their friends thoroughly acquainted with the interesting substance so honorably associated with his name. These sentiments were cordially responded to by the company.

ORGANIC CHEMISTRY.

CHEMICAL RESEARCHES *on* POISONOUS CHAMPIGNONS.

By M. GOBLEY.

ANALYSIS OF THE CULTIVATED MUSHROOM.

THE following investigations form the first part of a work which I have undertaken on poisonous champignons.

I considered that an analysis of the cultivated edible mushroom would serve as a basis and term of comparison.

Mushrooms are very advantageous as food, and in some countries they form an important part of the food of the inhabitants. The large proportion of albumen which they contain, the great quantity of nitrogenous matters, the saccharine matter, fat, and salts, found in them,—united to the delicate tissue of their vegetable fibre—all show that they must constitute a wholesome and very nourishing article of food.

If the botanical history of the champignon is well known, it is not so with respect to the action of these vegetables on the human body. Their properties do not attend their botanical affinities, and a very dangerous sort is often found by the side of a wholesome species. The same kind of champignon which is edible in one country, will be poisonous in another climate. Some likewise contain an acrid principle, and others a deleterious principle, which is not discovered either by the taste or odor, and which frequently causes death, if suitable aid is not within immediate reach.

* It is calculated that more than a quarter of a million sterling is annually expended, in the metropolis, on the paint necessary to protect the iron work of houses and other buildings from decay.

What is the nature of this acrid principle? what that of the deleterious matter? Our chemical knowledge is at present useless in this respect. We do not know whether all poisonous fungi act in the same manner; whether their injurious principles can be neutralised; whether any chemical characteristic exists by which the dangerous species can be distinguished from the innocent. I have taken upon myself to determine these points. Fully convinced of the importance of such an investigation, I shall use every effort to throw some light upon so interesting a subject.

M. Gérard has of late had the courage to repeat in Paris, what has been long done in the north of Europe. After having removed the poisonous principle from the fungi by prolonged maceration in vinegar, he has not hesitated to use them as food; but, while admiring M. Gérard's courage, we must observe that his experiments have only proved that the poisonous principle of the fungus is very soluble in water, for when their composition is carefully examined, we find, after washing, there only remains, besides the fatty matter, cellulose, a fine and delicate tissue it is true, but which has lost the pleasant flavor and nutritious nitrogenous matters, found in great quantities in this vegetable, so that it is difficult to say that the poisonous fungi prepared by M. Gérard's method, form a nourishing food; for they are, in reality, composed only of vegetable fibre, rendered agreeable by seasoning.

The chemical study of the various elements contained by the champignon has been already made. In 1811, Braconnot found:—1st, fungine, the fibrous part common to all fungi; 2nd, albumen; 3rd, a peculiar species of crystallisable sugar; 4th, adipocire; 5th, oil; 6th, wax; 7th, gelatine; finally, salts, such as the phosphate, hydrochlorate, and acetate of potassa.

In 1813, Vauquelin showed that the cultivated mushroom contained the same substances which M. Braconnot had found in the other species.

Although these works have been performed a long time ago, the results obtained bear testimony to the accuracy of their authors. My investigations add new facts to those which they have already announced, and enable me to show more precisely the nature of some of the bodies to which they called the attention of chemists. May we not, for instance, ask to what substance Braconnot and Vauquelin gave the name of adipocire? It is known that Fourcroy gave this name to three substances, which he considered to be only varieties of the same matter—the fat of corpses, the crystallised matter of biliary calculi, and spermaceti; although he had observed that these bodies had different degrees of fusibility, and that they were not equally soluble in alcohol. It was doubtless in accordance with these ideas, which were admitted at the time when Braconnot and Vauquelin made their experiments on fungi, that the name of adipocire was given to the solid fatty substance of the champignon. M. Chevreul has since proved, in his beautiful researches on fatty matters, that the fatty body of biliary calculi and spermaceti must not be confounded in one species, and that they both differ from the fat of dead bodies,

which he has ascertained to be a compound body. It was therefore important to examine whether the fatty matter of the champignon constituted a substance of a peculiar nature.

Is fungine a principle peculiar to the champignons and different from the vegetable fibre of other vegetables, as Braconnot thought? or, is it identical with cellulose, as admitted by MM. Payen and Fromberg, who have arrived at a complete affirmative on the points considered doubtful by Vauquelin. And if we accept this last opinion, what causes the difference in the characteristics which these two substances present in this respect?

Is the saccharine matter of the edible mushroom a species of crystallisable sugar peculiar to this vegetable? or is it not rather mannite, similar to that already found in many others?

To make these points more evident, it appears to me advisable to make a general examination of the analysis of champignons.

WATER.

The cultivated mushroom contains a large quantity of water. When divided into thin slices, and exposed in a stove heated to from 160° to 120° C. (230° to 248° F.), until it loses no more weight, it is found that it contained 90.50 per cent. of water.

ALBUMEN.

When subjected to strong and graduated pressure, champignons yield a pale rose-colored liquid, which soon becomes blackish on exposure to the air. This liquid is without action on litmus; when the temperature is raised above 70° C. (158° F.), it produces flocks, which, when collected on a filter and pressed, take a grey tint, and possess the properties of albumen; they contain nitrogen and sulphur.

To obtain the albumen, the champignons are cut in thin slices and treated several times with cold water, then triturated thoroughly with this liquid. The filtered liquor is then subjected to the action of heat, and the flocks which separate are collected on paper, constituting the albumen. When dry it possesses a deep black color; it contains traces of carbonate and phosphate of lime; it forms about 0.60 per cent of the edible mushroom.

It is the albumen which gives the firm consistence possessed by mushrooms when cooked; to it, likewise, is due the very unpleasant odor which they diffuse, when they decay after the termination of the period of vegetation.

CELLULOSE.

Braconnot, as I have observed, imagined that the substance which forms the tissue of the champignon was composed of a new body, to which he gave the name of fungine. According to this chemist, it differs from lignine by the presence of nitrogen and sulphur. My experiments have led me to a different opinion, and confirm the doubts entertained on this subject by Vauquelin. Braconnot obtained fungine by treating the champignon with boiling water containing a little alkali. By acting in this way, the whole of the albumen is not separated; it is in part coagulated and retained by the vegetable fibre. I have ascertained, that by braying the champignons in a mortar, with

distilled water, and carefully draining them, then subjecting them several times to the same operation, a body is obtained which contains no nitrogen, and which furnishes acid products by distillation.

It is likewise to this incomplete separation of the albumen, that must be attributed the black coloration of sulphuret of lead, mentioned by M. Braconnot, when a certain quantity of oxide of lead is added to water charged with the products of putrefaction of fungine. This phenomenon was not produced in my experiments, where the fibre of the fungus was completely exhausted by water, and contained only the fatty matter, and traces of carbonate and phosphate of lime.

The vegetable fibre of the edible mushroom, successively subjected to the action of potassa, chlorine, acetic acid, and proper washing with water, alcohol, and ether, gave me every evidence of the properties and chemical composition of perfectly pure lignine. I obtained the following numbers :—

Carbon	.	.	.	.	.	.	.	44.6
Hydrogen	.	.	.	.	.	.	.	6.0
Oxygen	.	.	.	.	.	.	.	49.4
								100.0

Consequently, my experiments fully confirm those of M. Payen. I cannot doubt that the lignous portion of fungi is identical with cellulose. This latter forms about 3.20 per cent. of the edible mushroom.

FATTY MATTER.

The cultivated mushroom contains several fatty principles. To separate them, I have lixiviated, by means of ether, in a displacement apparatus, mushrooms dried and reduced to a coarse powder. I obtained by evaporation about 0.25 per cent. of fatty matter.

This matter was dissolved in boiling alcohol; the liquid obtained, when cooled and filtered, contained oleic and margaric acids. I ascertained the nature of these bodies by combining them with oxide of lead; the two salts were separated by ether, and decomposed by hydrochloric acid.

The deposit remaining on the paper was taken up again by alcohol, and the whole was poured, boiling, on a filter. The soluble part was formed of a great deal of margaric acid, and a little oleic acid; the insoluble portion of fixed oil, and of a white and crystallised substance. By pressing between blotting paper, I succeeded in separating the fixed oil from the solid fat, which was purified by solution in boiling alcohol. In consequence of the sparing solubility of this substance in this liquid, it is necessary to employ a great quantity.

The fatty body with which the paper was impregnated, re-absorbed by ether, was formed of oleine and margarine.

I have not found the fatty acids of which I speak in fresh champignons; they are consequently the product of an alteration of a portion of the fixed fatty matter.

The crystallised fat of champignons constitutes a body of a peculiar nature. It has wrongly received the name of adipocire, and been considered by Braconnot as identical with spermaceti, which it only re-

sembles in its pearly aspect, for it differs from both these bodies, both in its properties and composition.

When purified by alcohol, this substance is in the form of small white micaceous scales, having neither odor nor taste; its point of fusion is very high; it melts between 148° and 150° C. (298° and 302° F.), and re-commences solidifying where the temperature is between 138° and 140° C. (280° to 284° F.), so that the real point of fusion of this fatty matter is 139° C. (282° F.). It is insoluble in water, sparingly soluble in cold alcohol; it is even difficultly soluble in this latter liquid when boiling; it is soluble in all proportions in ether. The alkalies do not appear to have any sensible action on it: 1 gramme of this substance was put into 30 grammes of distilled water, holding in solution 1 gramme of potassiuiretted alcohol. The mixture was boiled in a matrass for 24 hours, taking care to replace the water which evaporated. The liquor frothed; when shaken, some yellow flocks separated by repose, but almost all the matter retained its crystalline form. 4 grammes of potassa were added, and the boiling was continued for 12 hours; at the end of this time, it was diluted with water and thrown upon a filter; what remained upon it was treated with ether, and furnished a crystalline substance whose properties and point of fusion were those of the matter employed. The alkaline liquor contained no fatty matter.

Analysis gave the following composition:—

Carbon	78.40
Hydrogen	11.10
Oxygen	10.50
	100.00

The crystallised fat of fungi cannot consequently be considered as identical with spermaceti. Its very high fusing point, and its property of remaining unaffected by caustic alkali, makes it resemble cholesterine, but its sparing solubility in boiling alcohol, its less fusibility, and its composition, prevent us from confounding it with this substance. The solid fat of fungi must therefore be ranked near cholesterine, ambreine, and other fatty matters on which alkalies have no action, and I propose to give it the name of *Agariaine*.

MANNITE.

When the aqueous extract of champignons is treated with boiling alcohol, the decanted liquor deposits, in cooling, silky needles of a grey color, possessing a slightly sweet taste. They are not entirely separated by a first operation; for this purpose the operation must be several times repeated. The crystals, collected on a filter and decolored with animal charcoal, are perfectly white, and under the form of fine and silky needles. When they are dissolved in water and the liquor is allowed to evaporate spontaneously in a warm place, they are obtained under the form of long quadrilateral prisms with a square base.

This saccharine substance does not attract moisture from the air; it is very soluble in water; not so soluble in alcohol, except with heat, and, on cooling, is almost entirely precipitated. Subjected to the action

of fire, it melts at about 100° C. into a perfectly limpid liquid, which, on cooling, becomes a silky, brilliant, crystalline mass.

Nitric acid decomposes it, and transforms it into oxalic acid. When put in contact with water and a ferment, it gives no sign of fermentation, even after many days, and at whatever temperature.

Braconnot thought that this substance, when subjected to the action of beer yeast, underwent alcoholic fermentation. Vauquelin, on repeating the analysis of the edible mushroom, did not obtain sufficient to verify this fact. He was at first inclined to think that this sugar was similar to that which he and Fourcroy had found in manna; but he would not contradict Braconnot's assertion, and regarded it, therefore, as a species of sugar peculiar to the champignons. The properties of this substance do not permit me to doubt its being mannite, and my experiments again confirm Vauquelin's doubts.

But does the edible mushroom contain fermentible sugar, besides the mannite? I have subjected to the action of ferments, both the juice pressed from the cultivated mushroom, and that same juice reduced to a small volume by concentration, and I never obtained any trace of fermentation with either liquid.

SALTS.

The quantity of salts contained in the mushroom is very inconsiderable. To extract them, a certain quantity of mushrooms is triturated with distilled water and filtered; this treatment is repeated until the water no longer removes anything. The liquor is then boiled and filtered to remove the albumen which is coagulated; the liquor is then evaporated at a gentle heat, and contains, besides salts of mannite, an extractive matter soluble in water and in alcohol, and an extractive matter soluble in water and insoluble in alcohol; the weight of these substances united, forms about 5 per cent. of the mushroom.

If we afterwards estimate these different principles by first crystallising the mannite by means of alcohol, and then separating the two extractive matters, and incinerating them to obtain the fixed salts, this 5 per cent. is found to contain :—

Mannite	0·35
Salts	0·85
Extractive matter soluble in water and alcohol	1·80
Extractive matter soluble in water and insoluble in alcohol	2·00

Phosphates of potassa, chlorides of sodium and of potassium, and carbonate of potassa, form, with traces of phosphate and carbonate of lime, the fixed salts which I have found in the mushroom.

The extractive matter soluble in water and in alcohol, resembles what chemists call osmazome; it is of a reddish brown color, with a taste and odor analogous to that of salt broth. When dried at a moderate heat, it preserves its transparency and becomes brittle; in this state it powerfully attracts moisture from the air, and becomes once more a mass. Triturated with a little potassa and water, it disengages a perceptible odor of ammonia, indicating that mushrooms contain an ammoniacal salt.

The extractive matter soluble in water and insoluble in alcohol is of a deep brown color, with a strong flavor and agreeable odor of mushrooms; it contains nitrogen, and leaves, when incinerated, a saline residue, formed of the chlorides of sodium and potassium, phosphate and carbonate of potassa.

I have endeavored to ascertain what organic acids combined with the base of the alkaline carbonate in the vegetable. For this purpose, I have followed MM. Bolley and Dessaignes, and, like these chemists, I have ascertained, in the juice of the edible mushroom, the presence of malic, citric, and even fumaric acid, although the latter is in very small quantity. Fumaric acid is known to be identical with the boletic acid which Braconnot discovered in certain fungi.

Like Vauquelin, I have found in the cultivated mushroom neither animal mucus, wax, nor gelatine.

CONCLUSIONS.

From the above results I conclude:—

- 1st. That the edible mushroom contains 90·50 per cent. of water.
- 2nd. That it contains albumen.
- 3rd. That its vegetable fibre is formed, like that of other vegetables, of cellulose; that fungine cannot be considered as a proximate principle, and that it is on the albumen which it retains that the peculiar properties found in it depend.
- 4th. That the fatty matter of the mushroom is composed of oleïne, margarine, and a peculiar substance—*agaricine*—which is solid and crystallised, remarkable for its high fusing point, and by its property of not being altered by caustic alkali; Braconnot and Vauquelin have given the name of adipocire to this last substance.
- 5th. That the crystallised saccharine matter does not constitute a peculiar sugar; it is not susceptible of fermentation, and is, in fact, only mannite.
- 6th. That the cultivated mushroom contains a large proportion of extractive nitrogenous matters, some soluble in water and in alcohol, and others soluble in water and insoluble in alcohol.
- 7th. That it contains chlorides of potassium and sodium, phosphate of potassa, potassa, united probably with malic, citric, and fumaric acids, hydrochlorate of ammonia, carbonate and phosphate of lime.
- 8th. That the composition of the mushroom is in hundredths:—

Water	90·50
Albumen	0·60
Cellulose	3·20
Oleïne and margarine }	0·25
Agaricine }	
Mannite	0·35
Aqueous and alcoholic extractive matters	3·80
Chlorides of sodium and potassium, phosphate, citrate, malate, and fumarate of potassa	0·85
Hydrochlorate of ammonia, phosphate and carbonate of lime, &c.	0·45
	100·00

Such are the results of my examination of the chemical composition of the edible mushroom. This appeared to me a necessary work. I could not examine the special matters, which, developed in the poisonous champignons, have such a fatal influence on the animal economy, without having a term of comparison always at hand in the analysis of the edible mushroom. In a new work, which I hope soon to lay before the Academy, and which is in progress, I shall only have to establish the chemical differences which separate these approximate and yet varying vegetables. Every new body found in the poisonous champignons will be tried upon animals. I thus hope to isolate, and to describe the nature and physiological action of the principles to which are due the poisonous properties of these dangerous vegetables.

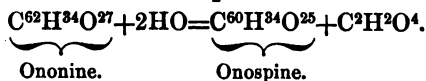
Journal de Pharmacie et de Chimie, February, 1856.

On the ROOT of the ONONIS SPINOSA. By M. HLASIWETZ.

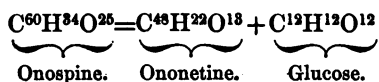
A CRYSTALLINE substance may be extracted from this root, ononine, which was first obtained by M. Reinsh. To isolate it, the decoction of the root is precipitated by acetate of lead. The precipitate is separated by filtration, and a current of sulphuretted hydrogen is passed through the filtered liquor. The ononine is taken down by the sulphuret of lead, and is extracted by means of boiling alcohol. The alcoholic solution, concentrated by distillation, deposits at first a small quantity of sulphur, afterwards a mass of yellow heaped crystals, which constitute the impure ononine. They are exhausted by cold alcohol in a displacement apparatus, to separate the resinous matters, and they are then purified by four or five crystallisations from alcohol.

Ononine forms, in the pure state, colorless lamellæ or heaps formed of small needles. It is sparingly soluble in boiling water; boiling alcohol dissolves it by degrees. Sulphuric acid dissolves it, forming a yellow solution which passes by degrees to a cherry color. When heated on a plate of platinum, it melts and then decomposes. Nitric acid transforms it into oxalic acid.

Baryta water divides it into *onospine* and formic acid.

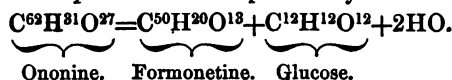


Onospine is a white, crystalline powder, fusible at 162° C. (321° F.), soluble in all proportions in boiling water. On cooling, the saturated hot solution becomes a crystalline jelly. Boiling alcohol dissolves onospine, and deposits it in prisms grouped in stars. The caustic alkalis and ammonia readily dissolve it. The ammoniacal solution deposits it in crystals by spontaneous evaporation. Concentrated sulphuric acid dissolves it, forming a yellow solution, which becomes purple on the addition of a little peroxide of manganese. It reduces the alkaline solutions of copper. Sesquichloride of iron colors the aqueous or alcoholic solution of a cherry red. Onospine is a glucoside. Dilute sulphuric and hydrochloric acids decompose into *ononetine* and glucose.



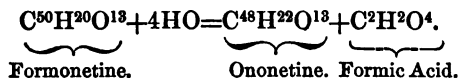
Ononetine forms, when pure, crystals grouped in stars, often long and friable prisms, fusible at 120° C. (248° F.), sparingly soluble in water, it dissolves in alcohol and readily in the alkalies. The ammoniacal solution becomes by degrees, in contact with the air, a beautiful green color. With sulphuric acid and peroxide of manganese it gives, like ononine and onospine, a red coloration.

When ononetine is heated with hydrochloric acid or dilute sulphuric acid, the liquor becomes filled with crystals of a new substance, to which has been given the name of *formonetine*. It may, in fact, be considered as a conjugate compound of ononetine and formic acid. The reaction which produces it is expressed by the following formula:



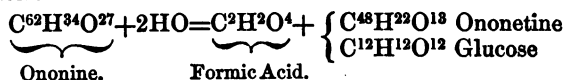
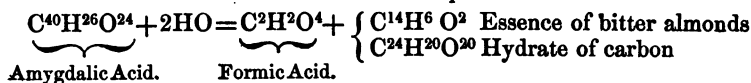
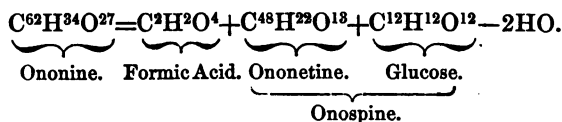
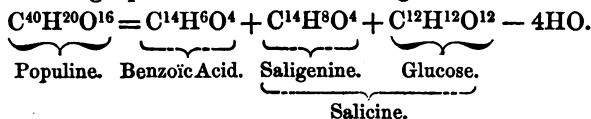
To purify formonetine it is dissolved in ammonia, to which solution is added a quantity of hydrochloric acid which is not sufficient to precipitate it completely. We thus obtain a gelatinous white precipitate, which is pressed between paper and dissolved in boiling alcohol, which on cooling deposits it in crystals.

When formonetine is boiled for some time with baryta water, it divides into formic acid and ononetine as follows:



Ononine may be compared to populine or amygdalic acid, which divide in a similar manner under the influence of acids or alkalies.

The following equations show these analogies:



The root of the *Ononis spinosa* contains, besides ononine, another crystalline body which can be extracted with alcohol. The alcoholic

solution when evaporated to a syrupy consistence deposits crystals which are purified by pressing them between paper, washing them with cold alcohol, and dissolving them in boiling alcohol. When pure they are very fine silky needles, whose composition is expressed by the empiric formula $C^{12}H^{10}O$.

This matter, which is completely insoluble in water, soluble in alcohol, neutral, resembles the waxy substances in its composition and properties, such as cerine, ceroxylene, cerosine, &c. It may be designated *onocerine*. Among the constituents of the *Ononis spinosa* must be reckoned citric acid and glycyrrhicine, or a substance which very nearly resembles it.

Journal für praktische Chemie.

An ALCOHOLIC LIQUID EXTRACTED from the HELLIANTHUS TUBEROSUS or JERUSALEM ARTICHOKE.

By M. DECHARMES.

M. DE RENNEVILLE, a distinguished agriculturist, having observed that the children whom he employed to collect the Jerusalem artichokes, constantly sucked the stalks in which they found a saccharine taste, thought that a vinous liquor might be obtained from them, and sent 300 grammes of them to a pharmacist at Amiens, M. Bénard, who operated on them in the following manner:—

The stalks having been cut with a root cutter, and divided in a marble mortar, were left to macerate in 400 grammes of cold water. After twelve hours the whole was pressed through a cloth. 300 grms. of a saccharine liquor were obtained, which marked 9 degrees of the saccharometer (density = 1.065); 300 grammes of cold water were then poured upon the pulp; and after twelve hours' maceration it was pressed again, and 300 grms. of a second saccharine liquid were removed, marking 5 degrees. A third liquid might have been obtained, for the pulp was not exhausted.

These two liquors to which yeast was separately added, soon underwent alcoholic fermentation, which continued for 48 hours. The liquors were then filtered; the first, which had marked 9 degrees of the saccharometer before fermentation, now marked only 5; and the second had lowered from 5 to 2 degrees. These liquors, especially the first, had a pleasant sweetish vinous flavor. The second was the color of Madeira wine; the other had a reddish tinge.

The result of this little experiment is, that with 50 kilogrammes of the stalks of the Jerusalem artichoke, we may obtain 1 hectolitre of a liquor, which is as strong as the strongest cider. The pulp may be given to cattle, who will eat it with as much avidity as they do that of beetroots, that have been used to make sugar.

The Jerusalem artichoke will grow in bad soils, and the stalks have hitherto been quite useless.

Comptes Rendus, No. 9, March 3rd, 1856.

TRANSFORMATION of various ORGANIC ACIDS due to an ACTION of PRESENCE. By M. LASSAIGNE.

THE interesting fact, communicated by M. Berthelot, of the decomposition of oxalic acid in the presence of glycerine, has recalled to me some observations which, without having the same practical interest, is so connected with what has been termed action of presence, that I should be glad to lay it before the Academy.

When malic acid is heated for several hours with hydrochloric acid, it is converted chiefly into fumaric acid; thus becoming dishydrated in the midst of water. Citric acid, treated in the same way, also becomes partially dishydrated, and produces aconitic acid. By evaporating to dryness, and heating the residue with ether, this latter acid is driven off, and citric acid remains colorless and unaltered, which, when subjected again to the same treatment, undergoes the same partial transformation, so that it can be decomposed into aconitic acid and water, without the production, at the same time, of those brown undetermined matters which accompany aconitic acid, when prepared by the dry method.

I have tried tartaric acid in the same way, and have entirely deprived it of racemic acid by reiterated crystallisations. I may, indeed, say, that I have never found any commercial tartaric acid, among the crystals of which I have been unable to trace racemic acid, after a prolonged dessiccation at 100°C ., by the appearance of white and opaque points. Pure tartaric acid, heated to ebullition for several days with hydrochloric acid, then contained about 3 per cent. of racemic acid, which had consequently been produced under those circumstances. The remainder of the tartaric acid was partly unmodified, and partly changed into a syrupy acid, which becomes concrete in the stove, presenting on its surface the appearance of the circumvolutions of brain. This acid seemed to be more stable than the modifications of tartaric acid obtained by the dry method, but I could not pursue the study.—*Comptes Rendus*, No. 10, March 10, 1856.

On CHRYSOPHANIC ACID. By M. ROCHLEDER.

CHRYSOPHANIC acid, $\text{C}^{20}\text{H}^8\text{O}^6$, identical with rheine, may be extracted from wall lichen (*Parmelia parietina*), or from rhubarb, by the following process:—

These substances are exhausted by weak alcohol, with the addition of a small quantity of caustic potassa. It is strained through a cloth, the residue pressed; it is filtered, and a current of washed carbonic acid passed through the solution. A precipitate is formed, which is collected, and dissolved in spirits of wine at 50°C . (122°F .), to which a little potassa has been added. The solution is filtered and precipitated with acetic acid. The precipitate is redissolved in boiling alcohol, mixed with water. The filtered alcoholic solution deposits chrysophanic acid in pure yellow flocks. It is purified by crystallising in alcohol.—*Journal für praktische Chemie*.

On the PRESENCE of OXYPHENIC ACID in WOOD VINEGAR.

By M. BUCHNER.

A SOLID and volatile acid may be extracted from wood vinegar, which M. Pauli considers identical with pyrogallic acid. According to M. Buchner, this acid should be identical with oxyphenic acid (phenic or pyromoringic of M. Wagner, pyrocatechine of M. Zwenger). Its composition is represented by the formula, $C^{12}H^6O^4$.

To extract it from the crude wood vinegar, this liquor is agitated with ether, the ether is distilled and the residue agitated with a solution of salt to separate the tarry matters. The acid in solution in the saline solution is again taken up by ether; the ethereal solution when evaporated leaves a residue which is subjected to fractioned distillation. At one moment of the operation an oil passes over, which forms crystals of oxyphenic acid; they are purified by pressing between blotting paper and subliming. These crystals belong to the rhombic system; they fuse at $111^\circ C.$ ($232^\circ F.$), and sublime without decomposing; they dissolve in water, alcohol and ether. In the presence of an excess of potassa, oxyphenic acid quickly attracts the oxygen of the air, like pyrogallic acid; its aqueous solution reduces the salts of silver, gold and platinum; the salts of sesquioxide of iron color it green; this color passes to a deep violet by the action of the alkalies. Hypochlorite of lime produces a green coloration, and by degrees, a black precipitate; bichromate of potassa gives a brown color to the solution of oxyphenic acid, which is quickly decomposed by all the oxidising reagents.

Annalen der Chemie und Pharmacie.

On FURFURINE. By MM. SVANBERG and BERGSTRAND.

MM. SVANBERG and Bergstrand have examined some of the salts of furfurine; we shall give a summary of their properties and composition.

Acid Sulphate of Furfurine.— $C^{30}H^{12}N^2O^6, 2(HO, SO^3)+7Aq.$

Short four-sided prisms, very soluble in water, sparingly soluble in alcohol and ether.

Acid Phosphate of Furfurine.— $C^{30}H^{12}N^2O^6, HO, 2HO, PhO^5.$

Prepared by supersaturating a boiling alcoholic solution of furfurine with phosphoric acid. On cooling it deposits crystalline lamellæ formed by right four-sided prisms, very much shortened.

Neutral Phosphate of Furfurine.— $2(C^{30}H^{12}N^2O^6, HO), HO, PhO^5.$

To 1 equivalent of the preceding salt is added 1 equivalent of furfurine dissolved in alcohol; the solution is heated and filtered. On cooling it separates in brilliant, anhydrous, oblique, four-sided prisms, unalterable in the air, soluble in water and in alcohol.

Basic Phosphate of Furfurine.— $3(C^{30}H^{12}N^2O^6, HO), PhO^5.$

It is prepared by adding an excess of an alcoholic solution of furfurine to a hot solution of the acid phosphate. On cooling, the basic salt is deposited in colorless, dull, anhydrous, long, oblique prisms,

unalterable in the air, very soluble in water and alcohol. Their solution is alkaline.

Acid Tartrate of Furfurine is deposited in oblique, four-sided prisms from an acid solution of furfurine in tartaric acid.

Journal für praktische Chemie.

On a NEW ALCOHOL EXTRACTED from a PECULIAR WHALE OIL.

By M. SCHARLING.

THIS alcohol was extracted from a lamp oil from the Greenland fishery. This oil is produced by a species of whale, which the natives of the Island of Færoë call *doegling*. M. Scharling has given them the names *doegtal* and *doeglic* acid, but we prefer the more euphonious terms hyperodic alcohol and hyperodic acid, taken from the name of *hyperodon*, which naturalists have given to this species of whale.

Hyperodic acid has been known for some years. The corresponding alcohol is of recent discovery. The author has even extracted it from the fat of the hyperodon itself; it contains it in a state of etherised combination with hyperodic acid, which is combined ethal. The hyperodic ether, being decomposed with potassa, produces an alcohol, which is liquid above the freezing point, which does not congeal at a temperature which freezes water.

M. Scharling does not continue his description further. He adds some results obtained by heating ethal with potassa lime to a temperature of 275° to 280° C. (527° to 536° F.). M. Heintz has obtained myristic, palmitic, stearic, and laurostearic acids, and he thence concludes, that ethal contains the alcohols of these acids. M. Scharling is of opinion, like ourselves, that these conclusions are exaggerated; he proves this by showing that ethal gives besides a certain quantity of butyric acid, and that this acid can only be produced by palmitic acid. M. Heintz will not conclude that this last produces butyric acid ready formed, nor that it contains the alcohol corresponding to that acid.—*Annales de Pharmacie.*

ANALYTICAL CHEMISTRY.

On MOLYBDATE of AMMONIA as a REAGENT for PHOSPHORIC ACID and ARSENIC ACID. By M. A. BECHAMP.

MOLYBDATE of ammonia was proposed by MM. Svanberg and Struve as the most sensitive and characteristic reagent for ordinary phosphoric acid, and all the published treatises on chemistry have since registered this discovery.

Arsenic acid, which is isomorphous with phosphoric acid, possesses at the same time most, I will say nearly all, the analytical and characteristic properties of it; so that if arsenic acid were less easily reducible into arsenious acid, arsenic, and sulphuret of arsenic, it would

be almost impossible to distinguish and separate them. This great resemblance had struck me, as it has many other chemists. Now, in making some analyses of these acids, I repeated MM. Svanberg and Struve's experiment, and I have ascertained that arsenic acid possesses this property as well as phosphoric acid, namely, the property of precipitating molybdate of ammonia of a yellow color, under the influence of a slight excess of nitric acid and heat.

As the success of the experiment depends very much, in both cases, on the concentration of the liquors, I should mention that I used a solution, saturated without heat, of the molybdate of ammonia, to which M. Delfs attributes the formula $2(\text{MO}^3) \text{H}^3\text{NO}$, HO. The salt was perfectly crystallised in oblique rhomboidal prisms. Now, if to 2 or 3 cubic centimetres of this solution, we add 15 to 18 drops of ordinary nitric acid, and bring them to the boiling point, the liquor does not become the least turbid; if we then add a few drops of a dilute solution of phosphoric acid or of a phosphate, the liquor becomes yellow, and when again boiled, the yellow precipitate appears; it appears just the same by adding a few drops of a very dilute solution of arsenic acid or of an arseniate. We must consequently ascertain the absence of arsenic acid, by means of Marsh's apparatus, before seeking for phosphoric acid with molybdate of ammonia.

Moreover, in certain circumstances, perfectly pure nitric acid will produce a yellow precipitate similar to that furnished by phosphoric and arsenic acids. For example: if, in the experiment which I have just mentioned, instead of adding 15 to 18 drops of nitric acid, we only add 3 or 4, and boil it, a yellow precipitate will sometimes appear, and this precipitate is not re-dissolved in nitric acid, even when added in great excess.

Molybdate of ammonia, being used very much in the search for small quantities of phosphoric acid, in the analyses of mineral waters, I have thought it right to make this little communication, and put chemists on their guard on this point.—*Journal de Pharmacie et de Chimie*, January, 1856.

INORGANIC CHEMISTRY.

NOTE on the ARTIFICIAL PRODUCTION by the HUMID WAY of CHLORIDE of SILVER (HORN SILVER) and on SEVERAL RESULTS of the REDUCTION of OXIDES or of NATURAL METALLIC SALTS.

By M. F. KUHLMANN.

IN a recent communication (*see THE CHEMIST*, p. 279) I have described to the Academy the artificial production by the humid way of several mineral species, determining the chemical reactions which may cause their formation through porous bodies.

The intervention of these bodies, by rendering the reaction slower, enabling us to obtain crystallised bodies, accounts in a satisfactory manner for the formation of certain natural crystallisations in matrices.

To these former facts, I have now added the artificial formation by the humid way of chloride of, or horn, silver.

To obtain this body, I operated in the following manner, having completely filled a flask with a solution of nitrate of silver, I closed the orifice at the neck with a plug of some porous body, such as asbestos, pumice stone, spongy platinum, wool, &c., the flask was then plunged neck downwards in a bath of hydrochloric acid, avoiding any entrance of air, so that the porous body is bathed on one side by the solution of silver, and on the other by the hydrochloric acid.

These two liquids soon come in contact through the porous body, and there is formed on the upper side of the plug a thin layer of precipitated chloride of silver, through which the reaction continues slowly, giving rise to an arborisation of chloride of horned silver, which extends its branches in the solution of the salt of silver. This chloride, which is at first white, becomes, under the influence of light, of a purplish brown. It has the semi-transparence, the conchoidal and vitreous fracture, the soft consistence, and the fusibility of the natural chloruretted silver, as likewise the same composition.

This artificial formation by the humid way of a matter with a vitreous aspect is not without interest in a geological point of view; it gives the key to the formation of a great number of minerals, which have the same physical properties, and likewise appear to have been fused.

As native chloride of silver is often found associated with metallic silver, it appears to me very probable, that the formation of the metal results, in this case, from the reduction of a portion of the chloride, and that it has all the characters of an *epigénie*. It has long been known how easily chloride of silver parts with its chlorine to nascent hydrogen.

When seeking for an explanation of this coëxistence in the same mineral masses, of metallic and chloride of silver, I have been led to pay attention to several examples of analogous reductions, which I mentioned in 1846, in a Memoir on the relation between nitrification and the fertilisation of land. In which Memoir I tried to explain the important part played by ammonia in nitrification, and I particularly mentioned, with respect to the fertilisation of soils, the ease with which, by an inverse action of oxidation, the nitric acid of the nitrates passes into the state of ammonia. These last facts supported an opinion which I had previously announced *that the nitrates exercise by themselves, and by the means of the ammonia formed by their decomposition, a salutary influence on vegetation.*

From this period I observed the curious phenomenon of an *epigénie* by the reduction, if not total, at least partial, of a metallic oxide. By passing ammoniacal gas through a tube containing crystallised binoxide of manganese, heated to about 300° C. (572° F.), I obtained protoxide of manganese retaining the crystalline form of the binoxide used for the experiment.

I have united to this one, many other examples, which, in a still more conclusive manner, support the explanation which I have given

of the formation of metallic silver, when accompanying the native chloride.

I have ascertained that under the influence of nascent hydrogen, all the salts of lead and copper may be restored to the metallic state, and that the metal which takes the place of these salts, although more or less porous, according to the nature, and the number of the displaced bodies, always affects the form of the crystals which have produced them.

Thus, by putting crystals of oxide of copper, carbonate and phosphate of copper, carbonate of lead, or artificial oxychloride of lead, in contact with zinc, and sulphuric acid diluted with water, there shortly takes place a transformation of the oxides or salts into metallic masses with crystalline forms.

These phenomena of reduction are produced when the minerals to be reduced are in immediate contact, at any point, with the zinc immersed in the weak sulphuric acid. The reduction is propagated little by little on the whole surface and thickness of the crystalline mass. To explain these reductions, it is not absolutely necessary to cause the intervention of the decomposition of water; the oxygen necessary for the formation of the oxide of zinc, which is to saturate the sulphuric acid, may be directly removed from the oxide to be reduced; nevertheless, it appears to me more logical to admit this decomposition as is usually done, for the phenomenon is not produced with concentrated acids, and besides this decomposition of water is powerful when the zinc, in contact with weak sulphuric acid, is used to remove the oxygen combined with the nitrogen in nitric acid; for, in this case, the hydrogen intervenes to form ammonia. This transformation of the nitric acid of the nitrates into ammonia is so complete, that it may be rendered useful in analysis, for the estimation of the nitrates.

My attention having been directed to the reduction of the metallic ores, by the combination of hydrogen with the metalloids, hydrosulphuric acid, which so rapidly blackens the salts of lead, copper, and silver, first fixed my notice. I soon obtained various *épigénies* by the simple contact, without heat, of this acid with various oxides or natural metallic salts. By passing a current of sulphuretted hydrogen through a glass tube in which the crystallised minerals were deposited, the reaction is immediate and frequently very rapid; an elevation of temperature is likewise occasionally apparent; the oxygen of the oxides is displaced in the state of water, and if we are acting on a metallic salt, the acid is set free and expelled, if the salt decomposed is a carbonate.

In the same way as with crystals of oxide or carbonate of copper, I have produced sulphate of copper; with native carbonate of lead, with fused oxychloride of lead, I produced sulphuret of lead, having the remarkable metallic lustre which distinguishes the galenas. In all these circumstances, the reactions, by a species of cementation, penetrate through the whole thickness of the mineral mass, and the sulphurets retain the crystalline forms of the oxides or of the metallic salts which served to form them.

By extending these reactions to the other combinations of hydrogen with the metalloids, I have obtained very varied results, to which I shall call the attention of the Academy on a future occasion.

Comptes Rendus, No. 8, Feb. 25th, 1856.

INDUSTRIAL CHEMISTRY.

On CIDER, its MANUFACTURE and PRESERVATION. The ADULTERATIONS which are PRACTISED with it, and the MEANS of ASCERTAINING them.

By M. FERON.

M. FERON has just published a work on this subject, which appears to us interesting on several accounts.

Cider is of great antiquity; the Hebrews called it *Sichar*, and the Greeks attributed its invention to Ceres or Osiris; the Romans called it *apple wine*, and Charlemagne mentions it. According to Huet, Bishop of Avranches, those ancient navigators, the Dieppoise, learned how to make it in the Basque Provinces, and introduced it into Normandy, where it has been in constant use ever since the sixth century.

THE MANUFACTURE.

Cider is made of the juice of the apple (*malus communis*), or of that of the pear (*pyrus communis*), and in the latter case it is called *Perry*.

Apples are divided into sweet, bitter and sour or acrid apples.

The first gives a clear and agreeable cider, but less generous than the second. That produced from the last kind is weak, and likely to become black; we shall describe further on the meaning of this technical expression.

Apples may again be divided into, 1st, tender, or that flower early; 2nd, seconds, or second flowering; and 3rd, hard or late flowering kinds.

The apples should not be used until ripe; those which are green, and which from any cause drop off the tree in this state, should not be used except in times of great scarcity, because they only give a little alcohol, and they produce an acid fermentation, which at last reacts upon the product obtained.

When gathered, the apples should be washed, dried in the sun, and then stored in a very dry room; where they attain a still greater degree of ripeness, which elaborates their principles and renders them fitter to make cider. It is disadvantageous to leave them long heaped up and exposed to any change of season, as is done in some places, because the rain removes the saccharine principle; we may likewise observe that if kept long in damp cellars, they acquire a mouldy odor, which always remains in the alcoholic product. We will now see why ripeness is so essential. When the apples are green they only contain 4.90 per cent. of saccharine matter; when ripe, this quantity is 11 per cent.; finally, when decayed, they contain 7.95. The rules to follow

in choosing the fruit are easily understood, and are as follows, according to M. Feron :—

1st. The apples are not to be pressed the moment that they are gathered, because they do not contain, at that time, all the substance which we require.

2nd. We must, likewise, avoid their becoming too ripe, because they will thus lose a quarter of their richness, besides the loss of juice, which is likewise the consequence of this state.

3rd. General rule. The best moment for pressing the apples, is when they have the following characteristics: fine yellow color, a sweet odor, soft under the finger without bruising.

The species is not unimportant because we thus know the richness of the saccharine principle of the fruit employed. MM. Barral and Converchel have observed that the density of the must varies from 4 to 12° Baumé, according to the quantity of saccharine matter contained in the liquid. By estimating the proportion of alcohol corresponding to each degree, they have formed a table which gives for each degree of the areômeter the quantity of alcohol sought.

The following table shows the relative richness of the three kinds of apples :—

	Density of the Must.	Alcohol.	
		Quantity.	Density.
Tender . . .	Baumé. 4 to 5°	1-15th	14 to 15°
Seconds . . .	7°	1-10th	16 to 17°
Hard . . .	8 to 12°	1-8th	19 to 20°

In Normandy the bruising is done by means of a heavy vertical wooden mill, moved by a horse. This has the inconvenience of not crushing the fruit thoroughly; many manufacturers have, therefore, introduced stone mills or channelled cylinders which grind it, fed by a hopper filled with apples. The grinding is then too perfect, the pulp is too fine, and the seeds themselves being crushed, not only give a mucilage which very rapidly ferments, but, likewise, a fatty oil with a very unpleasant odor.

The pulp obtained is then put into a press, and to give more resistance to the mass, a layer of pulp is alternated with one of horse-hair as is done in England and America. This latter substance is much better than straw, which frequently gives a disagreeable odor to the product.

The pressure produces cider of various qualities, that which runs the first is the richest in alcohol, and is called *great cider*, the second *medium cider*, and the third *small cider*. This last is always diluted with some water, which is added to the pulp to remove the last juice, and which acts by displacement.

The coloration of the cider is readily obtained by leaving it in contact with the pulp for twenty-four hours.

The expressed juice of the apples is put into a trough, in which it undergoes a first fermentation, which takes to the surface the greater part of the impurities which it contains. These are removed, and the liquid is then put into large casks, in which the fermentation is concluded.

When the fermentation does not proceed properly, a little yeast and sugar may be added, according to Professor Girardin, of Rouen, or according to M. Dubuc, of Evreux, 150 grammes of cream of tartar, and 62 grammes of good yeast per hectolitre.

It only remains to bottle the cider. We must add that stone-ware bottles, in consequence of their great strength, appears to us preferable to glass for this purpose.

PRESERVATION.

A popular prejudice has long existed, which consists in believing that the lees have an ameliorating influence on cider; M. Boussingault's experiments prove the contrary.

The alkaline malates precipitated by repose in the presence of alcohol, may be redissolved by agitation, and give cider a bad flavor; therefore, M. Feron recommends removing the lees from cider, and fining it like wine, which would, doubtless, render it fitter for transportation.

Turning is a fermentation, which is developed in the spring, in alcoholic liquids, and to which weak cider is peculiarly liable; it is remedied by fining the liquid, and transferring it to a sulphured cask.

Grease is a disease to which cider is very liable; it manifests itself by a bad odor, and a viscidness which causes the cider to be quite thready. M. Lefrançois proposes tannin to remove; if there is coagulation, it is fined and decanted. According to M. Malaguti, three litres of alcohol to seven or eight hectolitres, or 225 to 250 grms. of cachou will produce the same effect.

Cider, like wine, will sometimes turn sour; it has, therefore, been proposed to saturate the acid with carbonate of lime, lime, litharge, ashes, &c.; but these processes are defective in more than one point, and we much approve of the author's advice, which is, in such circumstances, to add sufficient sugar to the cider to regenerate the alcohol which has disappeared, or to distil it, or, finally, to convert it at once into vinegar.

We spoke at first of cider *blackening*. This phenomenon is occasioned by the alkaline malates, which, under the influence of a ferment, become transformed into carbonates, which turn the amber color of the cider to a violet black. M. Viau, of Honfleur, perfectly remedies this by adding 30 or 40 grammes of tartaric acid per hectolitre, which completely neutralises the alkaline salt.

ADULTERATIONS OF CIDER, AND THE MEANS OF DETECTING THEM.

These adulterations may be divided into three kinds.

1st. Adulterations made in the cider districts.

2nd. Adulterations made in Paris.

3rd. Adulterations which may be dangerous to health.

1st. The adulterations of the first category, are, *A*, the artificial coloration of the cider, and, *B*, its saturation when its acidity is too great. This coloration is produced with *coquelicot*, cochineal and caramel. It results from M. Feron's experiments, that the process of *Nees d'Esembeck*, which consists in pouring into the cider a solution of alum, (alum 1, distilled water 2,) and afterwards another, (carbonate of potassa 1, distilled water 8,) which added by drops, it results, I say, that this process succeeds the best to discover cochineal and *coquelicot*.

With cochineal, a carmine red precipitate is obtained, which disappears with an excess of alkali.

With *coquelicot* the precipitate is a brownish grey, and the filtered liquor passes blue in contact with the air, and in alkali.

For caramel, M. Fauré's method gives the most distinct results; the liquor preserves all the color due to the caramel, and gives a rose colored precipitate.

As for the saturation of the acetic acid, it is made with lime, soda or ashes, and is easily ascertained by a process indicated by Professor Chevallier. It is as follows: the cider is decolorized by animal charcoal, and evaporated to dryness. The residue is treated with alcohol, which dissolves the acetates, and separates the other salts contained in the cider. By evaporation alcohol leaves the acetate, the base of which is determined by its reactions.

2nd. The adulterations practised in Paris are imitations with artificial cider made with apples dried in ovens, which are soaked in syrup, marking 4 to 5°.

These ciders are distinguishable from the true ones by the quantity of alcohol which they give, and by the weight of the extract, which they leave after evaporation in the stove.

The greater weight of the extract from the ciders of Paris, proceeds from the sulphate of lime contained in the glucose, but, as the author truly observes, we must not attach too much importance to this fact, for the nature of the water used in the manufacture of the cider, may influence the proportion of precipitate obtained.

As for the adulterations, which are injurious to health, they consist in the addition of a certain quantity of brandy, intended to give strength to cider which is not in itself. The taste is perhaps the most accurate means of discovering this adulteration.

Finally, the saturation of the acetic acid by salts of lead or litharge, first recommended by Martin of Bavaria, may, as is well known, give rise to serious disease (saturnine poisoning); prolonged keeping in leaden vessels may likewise cause the same.

This metal is easily discovered in various cases; evaporation to dryness, carbonisation, reabsorption of the ashes by nitric acid, reabsorption by water, and the employment of the usual reagents for discovering the presence of lead; such is the most simple measure to be adopted in this case.

Journal de Chimie Médicale, January, 1856.

WORKING of the BORACIC ACID LAKE at MONTE ROTONDO
and the ADJACENT COUNTRY.

By M. H. DURVAL.

THE processes so long employed in the manufacture of boracic acid in Tuscany, are so well known as to require only a few words of observation.

Jets of vapor of various strengths escape naturally from the earth, containing boracic acid mixed with other substances; the whole is collected by causing the vapor to pass through a layer of water of about 0·60 metres, which retains the greater portion of the acid and the substances which accompany it. This water having settled, is concentrated almost to saturation in leaden boilers heated by steam, and on cooling, the ordinary commercial boracic acid crystallises out.

All boracic soils cannot be worked in this manner. Entirely new processes have been employed at Monte Rotondo with complete success.

The Lake of Monte Rotondo (commune of Massa Maritima) covers an extent of about $7\frac{1}{2}$ hectares; its waters are hot and sulphurous, and contain—

Boracic acid;
Free sulphuric acid;
Sulphate of lime;
 " of iron;
 " of alumina;
 " of ammonia;
 " of magnesia;
An organic coloring matter;
Traces of chloride.

Although these substances, in varying proportions exist in the waters of the Lake in very great quantities, these waters consist essentially of a solution of boracic acid; the other bodies must therefore be considered simply as impurities. The waters of the Lake contain only about 1 part of acid in 2000 parts of water, and in consequence of this small proportion of acid, this Lake was originally neglected as being unlikely to prove profitable.

The surrounding soil emits some weak jets of vapor; if employed in the ordinary manner they would prove very insignificant; and besides the solution of boracic acid was too weak to permit of the employment of combustibles.

An embankment intercepting the neighboring springs, and the chief part of the rain water have quadrupled the proportion of acid in the Lake, it now contains about 2 per thousand. Tubulated holes, and carried 45 metres, have furnished abundantly and cheaply the heat necessary for the evaporation of the water. Boilers with diaphragms, on which the water is constantly moving, and under which the vapor circulates without obstacle, evaporate on the average 160 litres per square metre each twenty-four hours; finally, the vapors which emanate from the artesian fires contain, in general, very con-

siderable quantities of boracic acid, which are collected by means of partial condensation, rendering the uncondensed vapors useful for the boilers. By these processes, the produce of a comparatively limited surface has been 65,000 kilogrammes annually at the end of 1854, and now surpasses 150,000 kilogrammes.

At the same time that the use of boracic acid has become more general, consumers have become more particular. At first, people were content with acid containing from 17 to 26 per cent. of impurities, and which, consequently, could not be used in the composition of enamel for English porcelain until it had been transformed into borax; now nothing but purified acid will be bought, and those which contain 15 per cent. of impurities are refused. At the Lake establishment these points are considered; therefore, the waters put into the boilers are previously purified, completely deprived of iron and alumina, and the acid extracted may be always maintained below an average of 10 per cent. of impurities. In this state it may be used directly for china and fine pipes, and for the crystal which some French manufacturers have begun to make by associating it with oxide of zinc.

Annales de Chimie et de Physique, March, 1856.

On ARTIFICIAL ULTRAMARINE. By M. STOEZEL.

THIS beautiful blue color, which was formerly so rare, and which, fifty years ago, was sold at the price of its weight in gold, has become less dear since M. Guimet taught us how to prepare it artificially with sulphate of soda, silica, alumina, and charcoal.

The quintal of ultramarine now costs about the same that an ounce used to do; the rapid success of this invention, and its great development, will consequently be clear. One question has, however, always puzzled chemists,—namely, the blue color of this substance. M. Stoezel's numerous experiments on this subject have led to very interesting results, although they have as yet failed to give any decisive proof with respect to the coloring principle of ultramarine. In the opinion of many authors iron is indispensable. M. Brunner asserts that he has obtained a very beautiful blue with materials which contained no iron, and when we consider that manufacturers obtain this blue without the direct intervention of any ferruginous compounds, we are authorised in doubting the active part which iron should take in this case.

Besides silica, aluminium, sulphur, and sodium, which are invariably found in all qualities of ultramarine, other elements are found, whose nature and proportions are subordinate to the process of manufacture; for the manufacturer frequently adds foreign matters purposely, either to modify the properties of the ultramarine, or to alter its tint. The author has met with a specimen which gave up, with ether, an appreciable quantity of an oily matter, which stained paper, and which detonated with heat, like a nitrous compound.

During the manufacture of ultramarine blue, there is produced

during the first calcination, a beautiful green color, which is beginning to be introduced into the manufacture of colored papers, &c., under the name of *green ultramarine*. The blue is not formed until after calcination with sulphur; when heated in a crucible, the nucleus of the matter is generally green, but it sometimes is red.

According to the author's analyses, green ultramarine presents a more constant composition than the blue; in the latter, the proportions of silica and alumina vary considerably. These analyses were made on products from the same manufactory, and which consequently proceeded from the same materials; and on comparing the results, we find that when passing into blue, the green color absorbs oxygen, and loses sodium and sulphur, which latter is in part transformed into sulphuric acid.

The following are the results obtained by analysis:—

	Green	Blue.
Al ² O ³	30.11	31.18
Fe	0.49	0.50
CaO	0.45	0.44
Na	19.09	11.10
SiO ²	37.46	38.11
SO ³	0.76	8.54
S	6.08	4.52
Cl	0.87	0.91
MeO }	traces	traces
KO }		
PhO ³ }		
	94.81	90.80
O	5.19	9.70
	100.00	100.00

The necessity of operating in contact with the air to obtain ultramarine blue, is well known. M. Pruckner proposes to calcine in a muffle, and agitate the mass. Another chemist, M. Brunner, in operating on a very pale ultramarine, tried in vain to heighten the color by calcination with sulphur and sulphuret of sodium; he at length succeeded by burning sulphur slowly round the substance.

When the calcination is performed in a porous crucible, the product is never homogeneous in color; there are always different shades in it, which are very interesting in a scientific point of view. In the interior of the crucible will sometimes be found a red nucleus, quickly modified by air and water. This color is enveloped in a green mass, which passes into blue as it approaches the outside. The blue ultramarine appears exactly when the air finds access. We must, however, observe that this only occurs when the amount of air in contact is not too considerable; in this case, the blue disappears at the circumference, and is replaced by a white matter. This is especially the case when the temperature is too high.

Another fact in support of the part attributed to the oxygen of the

air is, that the green matter frequently becomes blue when it is taken out of the crucible. Sometimes the sulphuret of sodium communicates pyrophoric properties, and when the mass enters into combustion, and disengages sulphurous acid, the blue color immediately appears.

In refining ultramarine, when we wish to give the product the most beautiful tint, the air is brought again into use, and to the crude ultramarine is added a certain quantity of flowers of sulphur, which is burnt as slowly, and at as low a temperature, as possible.

It may be supposed that one part of the oxygen absorbed has served to oxidise the sodium, and to transform one part of the sulphur into sulphuric acid; however, in this hypothesis a certain quantity of the oxygen remains unemployed. As ultramarine becomes decolorized in contact with the acids, abandoning sulphur and sulphuretted hydrogen, it has been concluded, that the blue coloration of this substance is due to polysulphuret of sodium. According to M. Stoelzel, the color would be due to a thionate, or to a hyposulphite.

Ultramarine exposed to various Decomposing Agents.

When subject to long calcination, out of contact with the air, artificial ultramarine becomes white; hypochloric acid no longer disengages anything but sulphurous acid. Heated in a platinum boat, placed in a glass tube, a little sulphur is sublimed, and sulphuric acid is disengaged, doubtless displaced by the silicic acid, which becomes powerful under the influence of the heat.

Green ultramarine behaves differently under these circumstances. When heated to bright redness in a closed vessel, it passes to a deep blue, which a higher temperature does not destroy. Hydrochloric acid disengages sulphuretted hydrogen from it.

The author has proved that blue ultramarine becomes white when heated in contact with dry hydrogen, or of an oxidising agent, such as nitrate of potassa. Chlorate of potassa communicates a rose color to it. In these circumstances, the green ultramarine passes first into blue, and then behaves like ordinary blue ultramarine.

Reducing agents, such as sulphurous acid and hydrogen, decolor both kinds of ultramarine; at a gentle heat, hydrogen separates sulphur and sulphuretted hydrogen: at bright redness, blue ultramarine becomes gradually grey, gives sulphuretted hydrogen by the action of hydrochloric acid, and resumes its blue color in the oxidising flame, but not without passing first into the green color; in some circumstances, the latter behaves in general like the blue.

Ultramarine may be kept for several days in a boiling ley of potassa or soda, without its color being affected; but if, after being introduced into a crucible, it is sprinkled with a little of these leys, and the moisture evaporated at a moderate temperature, an interesting effect of color is produced. At the edge of the crucible the blue ultramarine is transformed,—first to a green color, then to a reddish tint, which is unstable, and very soon passes to white.

This red coloration is easily obtained by slightly heating the green or blue ultramarine with some pieces of potassium or sodium; a slight detonation is produced; the red color is only produced at a certain

distance from the point which is in immediate contact with the potassium.—*Annalen der Chemie und Pharmacie*.

NOTE on the FECULA and ALCOHOL of the COLCHICUM (*Colchicum autumnale* LIN). By M. FERDINAND COMAR.

CHEMICAL analysis has proved the existence of fecula among the principles contained in the bulbs of the colchicum. It would even appear that Parmentier and M. Giobert formerly proposed the employment of this fecula as food; a proposal which has not hitherto, as far as I can learn, been rendered practically applicable.

By the advice of my master and friend, M. Lepage, pharmacist at Gisors, I have occupied my leisure in the extraction of this fecula, an operation which, when once the bulbs are deprived of the black skin which covers them, and then washed, is exactly the same as in the employment of potatoes; only that as the pulp of the colchicum very soon becomes brown by exposure to the air, it is better to put it into water as soon as it is obtained.

The fecula, being separated from the parenchyma, by means of a fine sieve, is washed with a great deal of water seven or eight different times, or, more properly, until the water is quite free from bitterness and *colchicine*. It is then drained and dried.

Thus prepared, the fecula is very white, with a soft agreeable taste, and completely innocuous, as I have proved by frequently using it as food, as well as several persons of my acquaintance.

The quantity of fecula contained in the bulbs of the colchicum is considerable, for the average yield which I obtained in three experiments, was 21 per cent. of the fresh bulbs. This result is sufficiently important to justify my calling attention to a plant which now infests, to a sheer loss, so many meadows and pasturages.

In their analyses of the bulbs of the colchicum, MM. Pelletier and Caventou mention the presence of a principle analogous to starch, *inaline*.

I have endeavored to separate this from my fecula, by means of water heated to 45° C. (113° F.), which, at this temperature, ought to melt it a little without acting perceptibly on the starch; but the result of my experiment was negative.

As the bulbs of the colchicum are rich in amylaceous principles, it was natural to suppose that by converting this principle into glucose, they might be used for the manufacture of alcohol.

An experiment which we made on this subject had the following result:—

We took 2 kil. 300 grammes of flour, representing 7 kilos. of the fresh bulbs, we mixed them with 10 kilos. of boiling water, to which we added 350 grammes of concentrated sulphuric acid, we maintained the ebullition, taking care to replace the water which evaporated, until the saccharification was complete. The conclusion of the reaction is, besides, easily ascertained by adding a few drops of an iodised so-

lution to a little of the cooled liquor, which no longer produces the violet coloration.

We saturated the sulphuric acid with chalk, poured the whole on a cloth, and subjected the strained magma to pressure.

The filtered liquor had a sweet taste, mixed with a slight bitterness, due doubtless to the presence of colchicine; it was concentrated to 10° of the arëometer, mixed with 60 grammes of yeast, and the whole was left at a temperature of about 25° C. (77° F.). Fermentation immediately commenced with an abundant disengagement of carbonic acid. After six days, the liquor possessing no sweet taste, and its density having descended to 3° of the arëometer, we subjected it to distillation, and we collected 2 litres of alcohol of 32° C., or 64 centilitres of absolute alcohol.

We consider that for manufacture, the starch contained in the colchicum could be transformed into glucose, by operating on the fine powder of the bulbs in large cisterns, by means of sulphuric acid and steam at 212° F., as with pure fecula.

We likewise think that by saturating the sulphuric acid with milk of lime, instead of chalk, as we did, greater part, if not the whole, of the colchicine would be precipitated, which in our operation was of no use, and had the disadvantage of communicating a bitter flavor to the glucose which we obtained.

We had not sufficient time to ascertain whether these opinions were well founded.—*Journal de Pharmacie et de Chimie*, January, 1856.

AGRICULTURAL CHEMISTRY.

OBSERVATIONS on the ABSORPTION of AMMONIA and the NITRATES by CRYPTOGAMIC VEGETATION.

By M. A. BINEAU, Professor of Sciences at Lyons.

IN the course of my chemical studies on rain-water and the atmosphere, many circumstances have led me to remark the effects produced by cryptogamic vegetation on the compounds of ammonia.

After the vacation last year, having taken up the liquids with which I had estimated ammonia three or four months previously, and having tested them afresh, I perceived a diminution of this alkali, wherever whitish organised bodies had developed themselves, whereas I found that the proportions of ammonia continued unaltered in those liquors which contain no organic production.

A short time since my attention was again directed to some analogous facts, in consequence of some peculiarities perceptible in the rain-water, collected at Oullins, by M. Lortet, who has for some months been kind enough to collect them for me and send them to me every eight or fifteen days. From the commencement of May a sudden change took place in the composition of this water, in which my experiments had until then always shown the existence of appreciable

quantities of ammonia; the atmospheric alkali entirely disappeared, and this continued for several months. I made the remark to M. Lortet, who then informed me that the flask which was the recipient of the water, had about that time begun to show those green organic products, whose development is so frequently under the influence of hot seasons and light. Each time that he put the water contained in the recipient into another vessel, he was careful to detach these green corpuscles as much as possible. But they always reappeared very quickly.

I have lately been making some special studies on the subject of the action of algæ on the ammoniacal salts, and the nitrates held in solution in the surrounding water. I have operated on the one hand, on an alga whose singular reticular texture shewed it to be *hydrodictyon pentagonale*, and on the other, on a conferva with long, intensely green filaments, which was found in a basin placed in the *Place Sathonay*, at the foot of the statue of Jacquard, and which appeared to be the *conferva vulgaris*.

About equal quantities of each of these algæ were enclosed in bottles with ground glass stoppers, which would hold about half a litre, with 250 cubic centimetres of water containing 12 millimoles of ammonia added in the state of hydrochlorate, and a rather smaller quantity of nitrate of lime. The bottles were then exposed, some in a window which received the sunshine until 11 o'clock, and the others near them, but so placed as to become nearly as warm, although remaining in the shade.

The experiment lasted for ten days. After this time the water in each bottle was filtered, throwing away the part that flowed first, lest it should be modified by the filter, and the last half of the liquors was subjected to an ammoniometrical test.

The following were the results obtained :—

	In the water containing			
	The Hydrodictyon.		The Conferva.	
	In the light.	In the shade.	In the light.	In the shade.
	Milligr.	Milligr.	Milligr.	Milligr.
Ammonia found in 1 decilitre	0.34	0.70	0.64	0.90
Whence we deduce—				
Ammonia in the total liquid	0.85	1.75	1.6	2.25
Ammonia absorbed by the plant..... 3—0.85=	2.15	1.25	1.4	0.84

Thus in the sun, the hydrodictyon caused the disappearance of nearly three quarters of the ammonia which originally existed in the

water, and the conferva, nearly half; in the shade the amount of alkaline base absorbed was only half that quantity.

Moreover, no appreciable trace of nitrate remained in the water of any of the four bottles in which the plant had vegetated.

An evident disengagement of bubbles of gas were, as usual, manifest under the influence of the solar rays, round the plants experimented on.

The two specimens of hydrodiction used in the experiment were dried in the open air, and weighed one 0.40 gr., the other 0.35 gr. The first, which had been in the sun, was bleached where most exposed to the solar rays; the aspect of the second was unchanged; both communicated a musty odor to the water, which passed off with distillation. As to the conferva, having been removed from its customary habit of existence in water which is continually renewed, it had suffered severely, for it began to putrefy, especially in the bottle in the shade. The experiment lasted too long for it.

I afterwards experimented on the conferva in a different manner. I took several portions of apparently equal size; they weighed about 15 grammes when impregnated with water, and 3 grammes when dry. Three of them were placed in stoppered bottles of 7 or 8 decilitres, containing half a litre of ordinary water, with the addition of 250 millionths of nitrate of ammonia, which corresponds to 53 millionths of ammonia, and to 169 millionths of nitric anhydride. The water, moreover, contained 2 to 3 millionths of this acid before the addition of the ammoniacal nitrate. One of the three bottles remained in the shade; another was in diffused light; the third received the direct rays of the morning sun, which shone every day during the continuance of this experiment. Finally, I exposed to the rays of the sun, two plates, one of which contained only the same liquid as the bottles, whereas, a sample of conferva was in the other. Evaporation was very active in the plates; but distilled water was added from time to time, to replace what had volatilised.

Having thus disposed the experiment, I removed one or two centilitres from the bottles each day to analyse. The following are the consecutive changes indicated by those analyses.

From 26 milligrammes of ammonia contained in each bottle, there had disappeared :—

	In the sun. Milligr.	In diffused light. Milligr.	In the shade. Milligr.
After twelve hours+	1	6	2 to 3
After three days+	2	8	7
After five days+	2	9	6
After seven days —	4	4	5

Thus, under the influence of the solar light, the amount of ammonia, after lessening imperceptibly at first, became stationary from the third to the fifth day, and augmented until it surpassed the original quantity, as indicated by the sign — placed before the result inscribed in the table; but a rapid destruction took place in the nitric acid.

The latter, whose original quantity was 86 milligrammes, disappeared in the following manner :—

	In the sun. Milligr.	In diffused light. Milligr.	In the shade. Milligr.
After twelve hours	4 to 5	4 to 5	3 to 4
After three days	86	15 to 20	15 to 20
After five days	86	35 to 40	50 to 60
After seven days	86	86	86

After the seven days had elapsed, the plant placed in the diffused light retained its normal appearance. In the bottle placed in the shade, putrid fermentation, which was not evident on the fifth day, was very evident on the seventh. Finally, the bottle exposed to the solar light began to exhale a putrid odor, similar to decayed cabbage, on the fifth day; the plant, which became pale colored on the first days of the experiment, passed into a state of putrid fermentation. At the end of the week, decomposition appeared to cause a portion of the filaments of the conferva to fall into shreds. It was, likewise, remarked that it developed 6 milligrammes of ammonia between the fifth and seventh days, thus finishing by increasing from 4 milligr. to the original quantity of that substance. On comparing the above facts with those produced in the first series of observations, with respect to this same conferva, we remark striking differences, proceeding perhaps from the superabundance of nitrate of ammonia in these last experiments. They are peculiarly evident under the influence of the solar rays. Putrid decomposition of the plant commenced much more rapidly than in the first series of experiments.

Might not this result be occasioned more by the heat than the light? We should be led to this belief by the effect observed with respect to the conferva placed likewise in the sun, but in a wide open vessel, in which evaporation diminished the heat. This gave no evidence of suffering. The liquid in which it was placed lost a third of its nitrate from the first day. The ammonia likewise diminished rapidly, but the same occurred in the plate, which contained no plant; this was doubtless the consequence of a volatilisation operated with the intervention of the carbonate of lime.

The facts which I have mentioned lead to the following results :—

1st. The demonstration of the fact of an absorption or decomposition of ammoniacal salts effected by plants, with an intensity analogous to that observed in the elaboration of carbonic acid, and in no way comparable with what has hitherto been described on the subject of saline matters, which are generally absorbed much less abundantly than their solvents.

2nd. The aptitude of the algæ to cause the disappearance of the nitrates from the waters in which they vegetate, whether they directly assimilate the nitrogen of the salts, or determine its passage into the state of ammonia, ready to aid in their nutrition.

3rd. The efficacy of light in facilitating the elaboration of the nitrogenous compounds by green vegetables, as well as that of carbonic acid.

Would the effects remarked with respect to some species belonging

to the last ranks of the vegetable kingdom, be produced equally with plants whose organisation is more perfect? Are they of a nature to constitute a general law of vegetable physiology. I have not had time to examine these important questions; but I shall endeavor to resume the experimental study which my occupations oblige me to lay aside at present.

Annales de Chimie et de Physique, January, 1856.

On the ACTION of SALTPETRE on VEGETATION. ADDITION to a FORMER MEMOIR. By M. BOUSSINGAULT.

My Memoir was already printed (*See* pages 219 and 295), when, in the interesting investigations of the Prince of Salm-Horstmar, I found an account of an experiment made in 1851, which establishes the fact that the alkaline nitrates act on vegetables, in a similar manner to the ammoniacal salts. I hasten to repair my omission in not quoting these results in the historical portion of my work.

"I was struck," says the Prince of Salm-Horstmar, "by seeing an oat plant thrive well in a soil in which nitrate of potassa had been substituted for the silicate of the same base. The plant, nevertheless, contained silica, which it had probably taken from the quartz constituting the soil; for it had purposely been watered as little as possible, with water which had been carefully distilled twice, and which was kept covered to avoid dust."

We likewise find, in the description of the experiment, that these oat seeds planted in pulverised quartz, deprived of every trace of organic or ammoniacal matters, but supplied with the mineral substances necessary for vegetation, and a certain amount of nitrate of potassa or nitrate of soda, produced plants of 17 to 20 centimetres in height, having 15 flowers producing 4 seeds, each of which was as large and as heavy as the normal seeds 0.036 gr. One of these plants when dried weighed fifteen or sixteen times the weight of the seed.

These experiments prove, adds the Prince, that the nitrates of potassa and soda may replace ammonia.—*Annales de Chimie et de Physique*, Feb., 1856.

PHYSIOLOGICAL & PATHOLOGICAL CHEMISTRY.

On SULPHO-CYANIDE of POTASSIUM considered as ONE of the NORMAL and CONSTANT ELEMENTS of the SALIVA.

By M. LONGET.

THE following are M. Longet's conclusions:—

1st. That *sulpho-cyanide of potassium*, which, according to the general opinion, should not exist normally in human saliva, but which is supposed to be developed under certain fortuitous circumstances, even when its appearance is connected with a pathological state, *ought*, on the contrary, to be considered as one of the normal and constant elements of that fluid.

2nd. That it is found not only in the mixed saliva of the mouth, but also in the parotidian saliva, and in the sub-maxillary and sub-lingual saliva.

3rd. That its presence is in some degree characteristic of the saliva, for the perspiration, urine, tears, cerebro-spinal liquid, the serum of the blood, and the serosity proceeding from vesicatories, have never given any trace of sulpho-cyanide; it is the same with the pancreatic juice of sheep and oxen.

4th. That this salt exists in the saliva in variable proportions, but always very small; these variations do not depend either on age, sex, diet, or peculiar conditions of the nervous system, *but simply on the degree of concentration of the salivary liquid.*

5th. That with a too great state of fluidity of the saliva, succeeding a very abundant excretion, the sulpho-cyanide may become inappreciable to reagents; but in this case it is only necessary to concentrate the salivary liquid by a slow evaporation, to obtain *always* the reaction characteristic of the presence of sulpho-cyanide, as I have observed in pyrosis, and mercurial salivations.

6th. The healthy state or morbid condition of the teeth, has no influence on the presence or abundance of this product, which is, moreover, found in persons who are entirely without any teeth.

7th. That the sulpho-cyanide is not the result of a spontaneous alteration of the saliva, as has been supposed.

8th. That to *isolate* it, as I have done, it is better to analyse the saliva of people who are fasting.

9th. That of all the free salts of iron, the perchloride is the best reagent to discover the presence of the sulpho-cyanide in the saliva; it gives to this liquid, *when sufficiently concentrated*, a beautiful blood red coloration.

10th. That no other substance, whether organic or inorganic, contained in the saliva, gives rise, with perchloride of iron, to the same reaction as the sulpho-cyanide; that it has been wrong to attribute this coloration to the presence of alkaline acetates in the salivary fluid.

Comptes Rendus, No. 10, March 10th, 1856.

On the EXISTENCE of INOSITE, URIC ACID, TAURINE and LEUCINE in the PULMONARY TISSUE. By M. CLOETTA.

THE lungs of a bullock were chopped up and digested for twelve or eighteen hours in cold water. The liquor obtained by filtration and compression of the residue was treated with a few drops of acetic acid, and coagulated by heat. The filtered solution was reduced by evaporation on a sand-bath to one-tenth of its volume, and precipitated with acetate of lead. Sub-acetate of lead formed an abundant precipitate, which contained uric acid and inosite; a certain quantity of amorphous matter, taurine and leucine remained in solution. The precipitate formed by the sub-acetate of lead was washed and decomposed by sulphuretted hydrogen. The filtered solution deposited, after twenty-

four hours, small white crystalline grains, which, under the microscope, had the appearance of uric acid, and possessed all the chemical characteristics of that body. The liquor which had deposited them was concentrated on a sand bath, then mixed with alcohol, and heated until the turbidness which appeared at first had entirely disappeared. After one or two days it deposited a crystalline mass, which was purified by several crystallisations from boiling water. A definite matter was thus obtained, having the form of rhomboidal crystals, whose obtuse angle was $138^{\circ} 2'$. At 24°C . (75°F .) they dissolved in 6.5 parts of water; they are insoluble in ether and cold alcohol. These crystals have a sweetish taste; they effloresce in the air, and at 100°C . they lose 16.7 per cent of water of crystallisation. Concentrated sulphuric acid blackens them with heat; the acids and dilute alkalis do not alter them even when boiling. The composition is expressed by the formula, $\text{C}^{12}\text{H}^{12}\text{O}^{12} + 4\text{H}_2\text{O}$. Their composition and properties are consequently similar to *inosite*, which M. Scheerer found in the muscular liquor. The solution of inosite does not become turbid with neutral acetate of lead; but the sub-acetate causes a gelatinous precipitate in it, which, when dried at 100°C . (212°F .), contains $\text{C}^{12}\text{H}^{12}\text{O}^{12} + 5\text{PbO}$.

The pulmonary liquid, precipitated by sub-acetate of lead, contains likewise taurine and leucine. After having separated the excess of lead by means of sulphuretted hydrogen, the filtered solution was evaporated to a syrupy consistence. This syrup contained alkaline acetates. Cold alcohol and dilute sulphuric acid were added to precipitate the alkalis in the state of sulphates. The filtered liquor, freed from sulphuric acid by baryta water, was evaporated until an equal volume of absolute alcohol, added to a small portion of the liquid, caused a precipitate. All the liquid having been treated with alcohol, the mixture was slightly heated so as to redissolve the precipitate. After several days the clear solution had deposited on the sides of the vessel groups of needles, which were purified by several crystallisations. By the slow evaporation of the aqueous solution this body crystallises in voluminous prisms; it is precipitated in needles several millimetres in length, when alcohol is added to the saturated aqueous solution. These crystals are unalterable in the air; their aqueous solution is neutral; they momentarily redden blue litmus paper. They are insoluble in ether. When made with caustic potassa and acetate of lead is added, a black precipitate is formed, an evident proof that they contain sulphur. In one word, their crystalline form and properties prove them identical with the taurine of the bile of cattle, which also momentarily reddens moistened litmus paper. Analysis likewise proves this identity. They contain:—

Experiment.			Theory.		
Carbon	.	"	C ⁴	.	19.2
Hydrogen	.	"	H ⁷	.	5.6
Nitrogen	.	11.2	N	.	11.2
Sulphur	.	26.4	S ³	.	25.6
Oxygen	.	"	O ⁶	.	38.4
					100.0

Three years ago M. Verdeil found in the lung, a nitrogenous and sulphuretted substance, to which he gave the name of *pneumic acid*. This was taurine.

The alcoholic mother liquor which had deposited the crystals of taurine, was evaporated on the sand bath, and the residue boiled with water and hydrate of oxide of lead. The liquor was filtered, freed from lead with sulphuretted hydrogen and evaporated to a syrupy consistence. After some time small crystals formed in it, having, under the microscope, the appearance of small lumps formed of concentric needles. These crystals had all the characters of leucine. To isolate this substance, the syrup was evaporated as much as possible, and exhausted by boiling absolute alcohol. The concentrated alcoholic solution deposited crystals of leucine, which were pressed between blotting paper, and purified by fresh crystallisations.

It was impossible to discover glycocolle in the syrup which had deposited the leucine.

Journal für praktische Chemie, tome, lxvi. p. 211.

PHOTOGRAPHY.

COLLODION ON PAPER. By M. STEPHANE GEOFFRAY.

PHOTOGRAPHERS have for some time been much occupied with the transfer from collodionised glasses. Your readers know of the application of gutta-percha to this purpose by Messrs. Archer, Reade, and Miller. Mr. Long has likewise given a method, which has its advantages; but all these processes are practically full of difficulties, and require immense care to produce occasionally a successful proof. Why not seek for a means of obtaining a layer of collodion on paper itself, preserving all the beauty and probability of success of collodion on glass?

I know that several processes have been proposed to obtain directly on paper very beautiful collodion proofs; but the half-tints of these proofs have not the delicacy of those on glass; the paper has an influence; its composition causes a reaction in the collodion, which injures its sensitiveness; on the one hand it may modify the rapidity, and on the other it may check the appearance, of the lighter tints. Moreover, the texture and porosity of paper has, hitherto, always affected the smoothness of the sensitive layer.

For this reason neither highly-sized paper, nor the albuminous paper, which I have already described, have given me perfect results; the *unwaxed* paper of M. Festeau, whose invention was a decided progress, is likewise unfit to replace glass, not having in a sufficient degree the two important qualifications of *inertia* and *impenetrability*.

Having, however, tried on glass the solution of gutta-percha, recommended by Messrs. Archer and Reade, I was struck with the idea of applying it to collodion for paper.

My very first experiments were perfectly successful; in fact, the

sensitive salts do not penetrate the layer of gutta-percha, and I obtained proofs, whose clearness and softness equalled the best of those on glass. I have since then used collodion only on paper, and my proofs are perfect.

I choose highly glazed papers; the nature of the pulp and quality of the texture are unimportant, provided that they are polished; for gutta-percha not only preserves the sensitive layer from the influence of the components of the paper, but likewise prevents the liquids used from swelling the paper, and deranging the texture. I fill an éprouvette as deep as my sheets of paper are long, with a solution of gutta-percha in benzine; I roll the sheets of paper, one by one, across the width, and dip them successively into the éprouvette. When the latter is full, and the bubbles of air which show themselves, have all come to the top of the bath, I remove the sheets and suspend them by one corner to dry.

A flat cistern may be used for the gutta-percha bath, but the surface permits of too much evaporation, and the bath would soon lose the excess of benzine which is necessary for complete limpidity.

To prepare the solution of gutta-percha, I put into a common bottle about 50 grammes of gutta-percha cut into small pieces; I add benzine until the bottle is about three quarters full, and cork it with an easy fitting cork, as the solution must be made in a sand bath. When the gutta-percha is dissolved the liquor has a yellow tinge; I let it remain in the cool for a fortnight, and even longer if necessary, until perfectly limpid. I then decant a perfectly clear and almost colorless liquid, with which I fill the éprouvette of which I have spoken.

When I wish to render the paper sensitive, I take the glass of my frame, place on it with a camel's hair brush a layer of glycerine, and cause the paper to adhere to this *fatty layer* without any air bubbles; then I put on the layer of collodion as usual, remove the paper, and put it into a silver bath of 6 per cent. I take care to keep the collodionised surface upwards, so as to avoid all chance of contact with the bottom of the cistern, which would mark it.

The iodide of silver being formed, I remove the paper, let it drain for a minute, wash it twice with water, so as to remove the nitrate of silver. I then replace it on the glass which still retains the glycerine, or which may have it replaced.

The sheet is then ready for exposure.

If the paper is to be left a long time before exposure, it is better to pour on the collodionised surface a mixture of glycerine and nitrate of silver, in the following proportions:—

Distilled water	.	.	.	.	.	grs.
	.	.	.	.	.	100
Nitrate of silver	.	.	.	.	.	1
Glycerine	.	.	.	.	.	15

Glycerine is equally soluble in water and in alcohol, and in certain proportions in ether; this renders its application to collodion very valuable. I develop the image as on glass.

When fixed I remove the sheet from the glass which supported it, wash it with care, dry it completely, and if necessary wax it.

I recommend this method especially to those who find that the polishing and transport of glass, its dearness and difficulty of preservation, are matters of importance.

I must add that the gutta-percha papers are easily used with albumen. The albumen on the paper gives proofs which are quite equal to those on glass, and it is a very certain and easy preparation to make.

Cosmos, April 11th, 1856.

The PHOTO-GALVANOGRAPHIC COMPANY.

WE have been favored with an inspection and explanation of the operations carried on by the Photo-Galvanographic Company, at their establishment at Holloway, and were highly pleased and satisfied with the efficacy of the process employed, and the beauty of the results obtained. We are indebted for the following statement of the *rationale* of the invention to Mr. Duncan C. Dallas, to whom we tender our thanks for his courtesy in showing us every part of the processes employed.

The *rationale* of the invention is as follows :—A peculiar photographic coating is placed upon a glass or other suitable plate. This coating, when dry, is exposed with the original to be copied, in a photographic pressure frame. The original may be a photograph, a drawing in chalk, sepia, indian-ink or pencil, an old print, or new print, either in lithography, copper or steel plate engraving, or typography, a leaf, or similar natural object, &c. &c. The more perfect the original, the better will be the copy. *Transparency in the lights, and intensity in the blacks* of the originals, greatly favor the production of good plates. When the coated plate has been sufficiently exposed, the original is removed from it, and an image is faintly visible, the surface remaining quite smooth. The plate is now placed in a bath, under the influence of which the picture starts out, as it were, into relief. By various treatments it can be preserved in this state or made to become sunk.

This is the foundation of the invention, viz., a picture in raised and sunk parts, instead of light and dark.

The next processes consist in obtaining a faithful copy of the coated plate, either by means of a mould to be copied by the electrotype, stereotype, &c., or by electrotyping direct upon the coating. By these and similar means, is obtained a printing plate. When necessary the print can be transferred either to zinc or stone.

Mr. Pretsch's invention being for the production of plates, the business of the company is directed on that object. The company intends to publish, from time to time, unique specimens; but the ostensible business is the production of engraved plates. The practical working of the concern is under the joint management of Mr. Pretsch and Mr. Dallas.

The company is now able to execute, for the illustration of books and the cerunic arts, engravings on a considerable scale, and at very moderate expense. It is scarcely possible to estimate the value to the public of this company's operations. We understand that the process

is likely soon to be applied to the production of surface-printing cylinders for calico printing.

We may observe, in conclusion, that the engravings exhibited to us left nothing to be desired. Every detail of nature or touch of art is most faithfully reproduced.

We have before us the prospectus of the company, and it gratifies us to be able to say that its statements are honest and reliable, and the prices such as to bring first-rate illustration within the reach of publications of moderate price.

PHYSICS.

On certain MAGNETIC ACTIONS and AFFECTIONS.

By Mr. FARADAY, D.C.L., F.R.S.

ALL bodies subject to magnetic induction, when placed in the ordinary magnetic fields between the poles of a magnet, are affected; paramagnetic bodies tend to pass bodily from weaker to stronger places of force, and diamagnetic bodies from stronger to weaker places of force. If the bodies are elongated, then those that are paramagnetic set along the lines of force, and those that are diamagnetic across them: but if these bodies have a spherical form, are amorphous, and are perfectly free from permanent magnetic charge, they have no tendency to set in a particular direction. Nevertheless, there are bodies of both classes, which being *crystalline*, have the power of setting when a single crystal is wrought into the form of a sphere, and these are called magne-crystals; their number is increasing continually; carbonate of lime, bismuth, tourmaline, &c., are of this nature. Bodies which being magnetic, set, because they are elongated, are greatly influenced in the force of the set by the nature of the medium surrounding them, and to such an extent that they not merely vary in their force from the maximum to nothing, but will often set axially in one medium, and equatorially in another. Yet the same bodies, if magne-crystallic and formed into spheres, though they set well in the magnetic field, will set with the *same* force whatever the change in the media about them, and are perfectly freed from the influence of the latter. Thus, if a crystal of bismuth formed into a sphere, or a vertical cylinder, has, when suspended, its magne-crystallic axis horizontal, and if the various media about it, from saturated solution of sulphate of iron, up to phosphorus, through air, water, alcohol, oil, be changed one for another, no alteration in the amount of torsion force required to displace the magne-crystals will occur, provided the force of the magnet be constant, notwithstanding that the list of media includes highly paramagnetic and diamagnetic bodies; and in such cases the measurement of the power of set is relieved from a multitude of interfering circumstances existing in other cases, and that power which is dependent upon the internal structure and condition of the substance is proved to be, at the same temperature, always the same.

A consequence of magne-crystallic structure is that the same body

is more paramagnetic, or more diamagnetic in one direction than in another; and therefore it follows, that though such a crystal may have no variation in set-force, produced by change of the surrounding medium, it may have a variation produced in the absolute force of attraction or repulsion; even up to the point of being attracted in one position and repelled in another, though no change in form, or in the surrounding medium, or in the force of the magnet, or in the nature of the body itself, be made, but simply a change in the *direction of the structure*. This was shown by a crystal of the red ferropotassiate of potassa, which, being coated carefully with wax, was suspended from a torsion balance so that it dipped into a solution of proto-sulphate of iron occupying the magnetic field.* When the magne-crystallic axis was parallel to the lines of force the crystal was attracted by the magnetic pole; when it was perpendicular to the lines of force the crystal was repelled; acting like a paramagnetic and a diamagnetic in turns. No magne-crystal has yet been found having such a relation to a vacuum, or to carbonic acid (its magnetic equivalent); calcareous spar is nearly coincident with such a medium, and shows different degrees of force in the two directions, but is always a little on the diamagnetic side. Calcareous spar having a trace of iron has been found very nearly up to the desired point, on the paramagnetic side; and as these preserve the full magne-crystallic relation of the two directions, there is no reason to suppose that a crystal may not be found which may not be paramagnetic in one direction, and diamagnetic in another, in respect of space as zero.

There is every reason to believe that the general magnetic relations of a magne-crystal are the same with those of the same substance in the amorphous state; and that the circumstances which influence one, influence the other to the same degree. In that case, the magnetic affections of a body might be ascertained by the examination of the magne-crystallic affections: thus the effect of heat upon bismuth, tourmaline, &c., might be examined by the set of the crystals; and with so much the greater advantage, that short globular forms could be used, perfectly free from the magnetic influence of the surrounding media required as temperature baths, and requiring no displacement of these media with the motion of the crystal. So crystals of bismuth, tourmaline, carbonate of iron, and other bodies, were suspended in baths of oil, water, &c., the temperature gradually raised and lowered, and the torsion force of the set for each temperature observed. With bismuth, a crystal having a force of 200 at 20° F. was reduced to a force of 70 at 300°, and the diminution of force appeared to be nearly equal in all parts of the scale for an equal number of degrees. A piece of amorphous bismuth, compressed in one direction, gave nearly the same amount and degree of change for the same alteration of temperature; leading us to the persuasion that the whole magnetic force of bismuth as a diamagnetic body would suffer like change. A crystal of tourmaline, which at 0° had a setting force of 540, when raised to

* 2½ volumes of saturated solution, at 65° F., and 1 volume of water.

300°, had a setting force of only 270: the loss of force was progressive, being greater at lower than at high temperatures; for a change from 0° to 30° caused a loss of force equal to 50, whilst a change from 270° to 300°, caused a loss of only 20. Carbonate of iron suffered a like change; at 0° the force was 1140, at 300° it was only 415; at the lower temperature the loss for 30° was 120 of force, at the upper it was only 34.

In all these and in many other cases, both with paramagnetic and diamagnetic bodies, the magne-crystallic differences diminished with the elevation of temperature; and therefore it may be considered probable, that the actual magnetic force changed in the same direction. But on extending the results to iron, nickel, and cobalt, employing these metals as very small prisms associated with copper cubes to give them weight, it was found that another result occurred. Iron, whether at the temperature of 30° or 300°, or any intermediate degree, underwent no change of force, it remained at 300, which was the expression for the piece employed under the circumstances. We know that at higher temperatures it loses power, and that at a bright red it is almost destitute of inductive magnetic force. A piece of nickel, which at 95° had a setting power of 300, when raised to 285°, had a power of only 290, so that it had lost a thirtieth part of its force; at the heat of boiling oil, it is known to lose nearly all its force, being unable then to affect a magnetic needle. Cobalt on the other hand, requires a far higher temperature than iron to remove its magnetic character, a heat near that of melting copper being necessary. As to lower temperatures, it was found that an elevation from 70° to 300° caused an absolute *increase* of the magnetic force from 293 to 333. It is evident, therefore, that there is a certain temperature, or range of temperature above 300°, at which the magnetic force of cobalt is a maximum; and that elevation above, or depression below that temperature causes a diminution of the force. The case is probably the same for *iron*; its maximum magnetic force occurring at temperatures between 0° and 300°. If nickel is subject to the same conditions of a maximum, then that state must come on at temperatures below 0°: and it may be further remarked, that as the maximum conditions occur in the following order for ascending temperatures, nickel, iron, cobalt, such also is the same order for the temperatures at which they lose their high and distinctive magnetic plice amongst metals.—*Read before the Royal Institution.*

TOXICOLOGY.

TOXICOLOGICAL STUDIES on CHLORATE of POTASSA.

By M. AUG. LACOMBE.

HAVING been employed to examine some organic matters in the body of a man who had died from taking a salt given by a druggist as sulphate of magnesia, and was correctly supposed to be chlorate of potassa, I made a series of experiments and investigations, which led me to positive conclusions. As the facts appear to me new, not

having met with a similar case in any toxicological work, I have determined to publish the method of investigation which I employed, and the reactions on which I relied in forming my judgment.

I had at my disposal some of the liquid which had been taken, and it was thus easy for me to prove the presence of chlorate of potassa by the characteristic reactions :

1st. Of sulphuric acid on the salt previously crystallised, and then dissolved in distilled water.

2nd. Of nitrate of silver, before and after calcination.

3rd. Of burning charcoal.

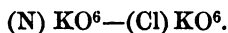
4th. Of certain reducing agents, of which I shall speak further on.

As for the base, I ascertained that by the ordinary means.

This liquid likewise contained sugar. To study this new element better, I transformed it by fermentation, and I then observed a peculiar phenomenon,—namely, that the chlorate of potassa, which was deposited in hexagonal lamellæ in the original liquid, on the least lowering of the temperature, in micaceous scales; after concentration in the same liquid was precipitated; after glucosic fermentation, in voluminous prisms—a peculiarity which I at first attributed to the acid state of the liquid, but which might have had some other cause.

Proceeding from the first fact, that the liquid which had been drank contained chlorate of potassa, it was evident that my attention must be directed to this body during the remainder of my investigation.

The analogy of properties and composition which it presents with nitrate of potassa, led me at once to have recourse to the same means of analysis as those employed in the search for this latter body. They are, in fact, both anhydrous; their base is the same; in both acids, the relation of oxygen to the radical is identical. Both unstable, they separate into powerful oxidisers, although in different degrees; and moreover, if we regard their elementary composition, setting the molecular grouping aside, we find that, in eight equivalents, they vary but in one :—



Unfortunately I could not obtain the slightest fusing, not a trace of crystals, not the slightest coloration with sulphuric acid. I at first attributed these negative results to the presence of organic matters, but how to free myself from it? I first macerated it without heat, alcohol gave me no satisfactory results; and there could be no recourse to sulphuric acid, which would have transformed the salt which I sought, nor to chlorine, which would have introduced an element into my solutions which I was anxious to avoid.

I observed that all the liquids, at whatever time I tested them, were always abundantly precipitated by nitrate of silver. By reflecting on this characteristic, as well as the property of the chlorates of being reduced when in ebullition by neutral and non-nitrogenous substances, I came to this conclusion, that by pursuing this course I ran the risk of annihilating the very body which I wished to find. I then decided upon proceeding by an indirect method, and operating solely without heat.

In the course of my manipulations, after precipitating all the chlorides normally existing in the liquid produced by washing the intestine, I wished to precipitate the excess of the silver salt by a current of hydrosulphuric acid, so as to seek for traces of the chlorides in the result of the calcination of this liquid, a presumption, in this case, of the pre-existence of a chlorate. The current of hydrosulphuric acid at first precipitated the salt of silver, of a black tint, but soon there appeared an abundant white precipitate, which I recognised as being chloride of silver.

Thus, in the various attempts, attempts which will be well understood by all those who have such awkward problems to solve, I arrived at two essential facts.

1st. The impossibility of employing heat, without being exposed to the danger of reducing the chloride by the neutral and non-nitrogenous bodies of the organism.

2nd. The possibility, by means of a reducing agent, of instantaneously transforming the chlorate into a chloride, and precipitating it in the presence of a silver salt.

I shall explain the *modus operandi* in a few words.

In the first place nitrate of silver must be avoided, because, as this salt possesses certain properties similar to the chlorates, if the liquid, thus treated, manifested them, doubts or confusion might arise in the mind. Acetate of silver offers none of these disadvantages; and I obtained it easily by precipitating nitrate of silver with a carbonate, dissolving in acetic acid and purifying by several crystallisations.

The fact of the reduction of iodates by sulphurous and hydrosulphuric acid is well known; iodine reducing the chlorates at the boiling point, the reduction of the chlorates by sulphurous and hydrosulphuric acids is deduced *à fortiori*, and the reaction which I have analysed above consequently receives a clear and simple explanation.

I took 5 centigrammes of chlorate of potassa, and dissolved them in 1 kilogramme of distilled water; I took a tenth part of this liquid and mixed it with 900 grammes of distilled water; I repeated this a third time, so that I had a liquid containing 5-10ths of a milligramme of chlorate of potassa, a quantity which may be considered as imponderable. I passed through it a current of sulphurous acid in the presence of nitrate of silver: the reduction was instantaneous, and in the precipitate formed, it was easy to find all the characteristics of chloride of silver. The degree of delicacy of this reaction may be considered as indefinite, and I think it superior even to that of Marsh for the discovery of arsenic, especially when we consider that, in this case, we can operate on liquids without any other preliminary precaution than the precipitation of the normal chlorides.

1st. The liquid of the macerations being filtered, it is treated by an excess of acetate of silver; it is filtered again and a current of sulphurous acid is passed through it obtained by the action of sulphuric acid on mercury, taking great care to ascertain that no hydrochloric acid passes too. If the liquid contains a chlorate, a white precipitate is immediately formed, which is insoluble in acids, soluble in ammonia, and turning brown when exposed to the light.



As will be seen, the reaction takes place between five equivalents of sulphurous acid, and one equivalent of chlorate of potassa.

2nd. Into a new quantity of the same liquid is passed a current of hydrosulphuric acid obtained by the action of dilute sulphuric acid on a sulphuret of iron, resulting from the direct action of sulphur on iron.

If the liquor is alkaline the action appears to be negative, whether it really is so, or whether, which is more probable, it is only concealed; and a black precipitate of sulphuret of iron is formed.

But if sulphuric acid is added the chloric acid is immediately reduced, and the precipitate is formed, which is identical with the one which we have previously described.

The liquor being neutral or slightly acid, it is very evident that the acid which these reactions have revealed does not exist in the free state; it is consequently neutralised. What is the base? The liquids of these various treatments are filtered, concentrated, and the characteristics of potassa are sought for in it; but as this alkali exists in the economy itself, the question of quality becomes complicated with one of quantity.

Having ascertained the potassa, it results that the oxacid of chlorine whose reactions have been analysed, cannot be perchloric acid, because of the sparing solubility of the salts which it forms with this base; it cannot be hypochloric acid, because its salts have a decolorising action not possessed by the chlorates; it is, therefore, chloric acid.

Toxicologically speaking, the affirmation should be come to with great timidity, when we are unable to isolate the suspected body, and the proofs by reaction should have but secondary weight: those which I have indicated are, however, so precise, and so delicate, and are supported by such incontestible chemical facts, that I consider them likely to render great service, whenever the experimentalist has before him a trace of matter upon which he can act directly; and this was the case at this time.

50 grammes of chlorate of potassa had been taken on this occasion. Supposing that as a neutral salt its purgative action is analogous to that of the most commonly used salts, sulphate of soda, and sulphate of magnesia, sulphate of soda containing 26 per cent. of water, and sulphate of magnesia crystallised at 15°, 50 per cent., it results that chlorate of potassa, being anhydrous, should act in a similar manner to 114 grammes of sulphate of soda, and 100 grammes of sulphate of magnesia. But its action must be more complex, and I wish to call the attention of observers to one important point. All my liquids, even those of the fourth washing, were abundantly precipitated by acetate of silver. With this constant reaction before me, I considered whether chloride of potassa might not have an exclusively irritating action; whether, under the influence of the vital heat, reduction would not have been possible.

In this case, what would be the nature of the alterations of the liquids of the animal economy? What would be the limit of the power of this unknown action? I must leave this question to other

experimentalists, being quite certain of the point from which I started, but ignorant to what it may tend.

Journal de Chimie Médicale, April, 1856.

On the POISONOUS PROPERTIES of BRINE.

M. REYNAL lately read to the Académie de Médecine an interesting Memoir on the poisonous properties of brine. Everything which can throw any light on this important subject should be collected; we shall therefore give an extract from a note published with the initials, Dr. B. S., and who makes known some new facts on this subject.

M. Adam, municipal veterinarian at Augsburg, tells us that in one establishment in that town, thirteen pigs were kept, whose ages varied from six to eight months; they were put by twos and threes, in very well constructed sties, and fattened with the residue from a brewery mixed with water. This food especially agreed with the older pigs; all ate it with appetite, even when this sweetish substance had become slightly fermented by heat in the month of March.

On the 29th of last April, the meat from fifteen pigs was taken out of the brine in which it had been salted, and the residue, consisting of about 15 quarts of brine, was poured into the tub in which the food for the pigs was always mixed.

The next day, the man who attended to them observed that two of the pigs, in different sties, showed very little appetite, although they continued lively. By noon of the same day, all the pigs had lost their appetites. At 1 o'clock, when M. Adam was called in, four were in a state of decided vertigo; they were sitting on their hind legs like dogs, supporting themselves on their front legs, which were wide apart, and they made motions of mastication, which caused foam to appear on their mouths; then came on strong convulsions, they fell on their sides, and their legs stiffened with short spasmodic actions. In a short time this ceased, the pigs rose, slowly changed their places, keeping their heads down; the vertigo continued with such intensity that they struck their heads against the wall. After an interval, varying in different animals from half an hour to an hour and a half, the same paroxysms returned with increased violence, and continued slightly, even during the intervals of the convulsive movements. At length they could no longer rise, their respiration was calm and deep, and they uttered no sounds of complaint; the skin assumed an uniform tint, showing no marks either red or blue; the temperature was natural and uniform; the mucous surfaces of the mouth and nose were of a pale pink; the eyes were bright, the pupils dilated, the sounds of the heart were weak, and the pulsations 24 in the minute; there were no longer any alvine dejections; the hind part was much sunk down.

The animal which appeared the worst was killed by the section of the carotid; the blood was dull red, it coagulated rapidly; the clots separated distinctly from the serum, which was of a dirty white and shining; the muscular flesh was firm and of a reddish brown; the fat was a beautiful white; the stomach was much distended by a thick

mass of chyme; the mucous membrane, which was a dirty white, covered towards the pylorus with grey, greenish, yellow pus, presented some red stains; in the duodenum the mucous membrane was likewise stained with red patches; the large intestine contained solid hard matters; even in the rectum the mucous membrane was dry, and covered with a gluey matter. The liver, spleen, kidneys, and bladder, were healthy. The lungs were bright, red, and crepitating; the heart contained a very little coagulated blood; the sinus slightly distended with blood; the cerebral substance much infiltrated, presenting here and there a sandy aspect, and appeared less consistent in its substance than in the normal state.

Two more pigs were taken ill on the same day, and killed with the four others, when there was no longer any hope of saving them. The examination of the dead bodies showed the same condition in all; the peculiarities in the blood and dryness of the mucous membrane was unailing.

The meat of these pigs, which looked quite right, was eaten by several persons, both fresh and salted, and produced no accident.

The seven other pigs, among which were the five oldest, did not present such alarming symptoms, although all lost their appetite for some days.

The treatment used was first a vomit of stibiated tartar and white hellebore; then, injections were used; only two of the pigs vomited; but the greatest benefit was obtained by bathing them all over with cold water.

The German veterinarian has, moreover, observed that the cases of poisoning with brine which he has met with, have always occurred in hot weather, although meat is more often salted in the autumn and winter. He thinks that this is an argument in favor of the theory which attributes the poisonous nature of brine to the presence of a fatty acid engendered under the influence of heat.—*Moniteur des Hôpitaux*, No. 133.

TOXICOLOGICAL and PHARMACO-DYNAMIC STUDIES on ACONITINE.

By DR. VAN PRAAG.

AFTER giving the history of the discovery of this substance, he mentions the experiments which have been tried on dogs, rabbits, birds, frogs, and fishes; he then arranges the results so as to show its mode of action.

Aconitine lessens the respiration; paralyses the muscular system which is guided by the will, and stops the cerebral nervous action; it appears to be almost without influence on the circulation, at most, it only renders it variable and irregular. It produces dilatation of the pupil, and an augmentation of the salivary secretion, whereas the urinary secretion does not appear to be modified by it. It causes in man a peculiar painful sensation in the cheeks, in the upper jaw, and forehead; it causes death by asphyxia. As for the diseases in which it is recommended, the author says little about them. It ought to be

useful in delirium and mania from excitement. It might likewise be recommended in cramps, tetanus, trismus, chorea, and spasmodic asthma, when purely nervous.

The highest dose which the author has been able to give without danger, was three quarters of a grain (0.0488 gramme).

Without giving any further opinion on the efficacy of this medicament, the author thinks that aconitine acts most frequently in the same manner as the alcoholic extract of aconite, but it is preferable to all other preparations in consequence of the equality of its action, whereas the plant may be more or less active, according to the localities where it is collected, the season, and other circumstances which influence its vegetation.—*Journal des Connaissances Médicales*.

POISONING by COLCHICUM. REACTIONS of COLCHICINE.

By DR. CASPER.

THE cases of poisoning with colchicum are very rare, which is a very fortunate circumstance; for we have as yet very imperfect notions as to the principle to which its action is due, and chemists have at most only caught a glimpse of it, in the course of the numerous experiments to which they have subjected the various parts of the plant.

A case has, however, lately taken place; four persons have died poisoned, by having drank each one glass of a liquid which came from Berlin, and which was, in fact, the officinal tincture of the seeds of the colchicum.

Dr. Casper has ascertained its nature as follows:—

The liquid was evaporated to the consistence of a syrup, then reabsorbed by absolute alcohol, with the addition of tartaric acid; it was filtered and again evaporated, a small quantity of water was then added, which separated the oily matter; the liquid was saturated with bicarbonate of soda and again filtered, then mixed with 4 volumes of sulphuric ether, and the mixture agitated for a few minutes. Then, by abandoning the supernatant liquor to spontaneous evaporation, a residue was obtained, which, according to Dr. Casper, was colchicine.

Its characters and reactions resembled a sample of this substance, which was carefully prepared by M. Müller, of Breslau. The taste was acrid and bitter, but not burning. The aqueous solution, treated with tannin, gave a voluminous white precipitate, soluble in alcohol; with tincture of iodine, it gave a reddish brown precipitate; with chloride of platinum, a yellow precipitate. Concentrated nitric acid dissolved this residue, giving a violet color; concentrated sulphuric acid developed a deep yellow color, which soon turned to a dirty green.

The four persons who had drank this liquid having all died, and a post-mortem examination having been made on one, Dr. Casper determined to seek for colchicine in the liquids of the stomach.

After having ascertained that they contained no metallic poison, he mixed them with absolute alcohol, filtered the mixture, and evaporated it to a syrupy consistence; then reabsorbing the residue with alcohol,

to which tartaric acid had been added, he went through the series of experiments which we have just described. Finally, he obtained, by the evaporation of the ethereal solution, a residue analogous to the preceding, in which all the reactions of colchicine were evident.

According to these experiments, which there is every reason to believe exact, Dr. Casper thinks that it is very easy to discover, and even ascertain, the fact of poisoning by colchicum, which is very important, *colchicine* being one of the most powerful known poisons. M. Schacht, a German chemist, to whom the legal management of this case was entrusted, expresses himself as follows :—

“It is difficult to form an idea of the activity of colchicine as a poison. Each of these four victims had taken about a glass of the official tincture of the seeds, and, supposing that the glass was full, which is not certain, they would each have taken, at the utmost, 125 grammes of liquid, representing 30 grammes of seeds. Now, M. Müller treated 500 grammes of seeds, and extracted only 25 centigrammes or 5 grains of colchicine from them. This quantity is, doubtless, less than they really contain; but, on the other hand, the formula indicated by the Codex for the preparation of the tincture does not permit of the complete exhaustion of the seed. The quantity obtained by M. Müller may be considered as a sufficiently near approximation to the proportion of colchicine which the tincture contained in solution. According to this hypothesis, these four victims can only have taken about 25 milligrammes, or half a grain, of colchicine, and this very small quantity was sufficient to cause death in a very short time.”

There are two objections to M. Schacht's theory. The first is, that the estimation made by M. Müller, which fixes the proportion of colchicine contained in 500 grammes of seeds at 25 centigrammes, is doubtless much below the real proportion, because of the loss inevitable in experiments of this nature. The second is, that the colchicine does not, probably, contain the whole of the poisonous properties of the seeds, and that the tincture decidedly contains another principle, which chemistry has not yet explained, and which, perhaps, has quite as deleterious properties as colchicine, with regard to the animal economy.

Notwithstanding these necessary reservations, the preceding observations are both very important and very interesting.—*Journal de Pharmacie et de Chimie*, February, 1856.

MATERIA MEDICA, PHARMACY, AND THERAPEUTICS.

NOTE on GLYCERINE.* By M. CAP.

As I anticipated in my former Memoir, read to the Imperial Academy of Medicine, Jan. 17, 1854 (*see* THE CHEMIST, New Series, Vol. I.), glycerine has for some time past attracted the attention of the medical public. The employment of this substance in medicine has found ardent propagators, and zealous and skilful experimenters, whilst other practitioners have been reserved, and have expressed some opposition

* Read to the Société de Pharmacie, Feb. 6, 1856.

on this subject. This must happen; it must even be always desired, for the free and complete manifestation of truth in a scientific matter. I have kept out of these discussions, in which, moreover, I could only interfere in a chemical point of view. I have confined myself to collecting all the facts which relate to this special branch of my researches, and when I have been requested to speak as having been one of the first to throw some light on the remarkable properties of glycerine, I have replied that, for the moment, I had nothing to add to what I had announced in my first Memoir, and, a short time after, in the work which I read to the Society, in conjunction with M. Garot, on the glyceric medicaments and glycerolates, reserving to myself to return to this subject, when I should have new documents to produce, concerning this very interesting body.

As the researches which we are following up must always be of rather long duration, we have thought, that from this time, we had some authority for recapitulating the progress made by the researches relative to glycerine and its medical use, for saying a word on the processes relative to its preparation, in order to indicate its principal characters, and the means of detecting the most ordinary adulteration of this substance. This is the object of the present communication.

Without recurring to the history of the first attempts relative to the employment of glycerine, and which I have enumerated in my first Memoir, I may be permitted to mention, that in a sealed packet which I deposited with the Academy of Sciences, nearly five years ago. (July 28, 1851), I announced:—1st, that glycerine considerably softens the skin and cicatrises its fissures, that it was of remarkable efficacy in the treatment of affections of that organ; 2nd, that it might be employed as baths, lotions, injections, &c., that it protected burns and wounds from contact with the air, and kept the edges of the eschar in a state of suppleness; 3rd, that it prevented cataplasms from drying, that it might be mixed with pommades, cerates, soaps, and *savonules*; 4th, that the preparation of perfumery to which it was added, acquired powerful cosmetic properties; 5th, that glycerine preserved in the fresh state, organic substances, alimentary or otherwise; 6th, finally, that in the weaving and dressing of tissues, it advantageously replaced the mucilages and hygrometric size.

After having thus proved my right of priority in the announcement of most of these facts, it was necessary for me to employ myself in manufacturing glycerine on a large scale. The little importance hitherto attached to this singular body, although it is produced abundantly in soap works and stearic acid manufactories, had caused it to fall almost into oblivion. The mother liquors containing it were daily thrown away and lost. The insupportable odor of impure glycerine, obtained by the evaporation of these mother liquors, contributed to the rejection of its employment; whilst prepared chemically, it was so high in price as to lead us to renounce the idea of its industrial applications, and even, to a certain extent, to its medical use.

My researches were therefore necessarily turned to the object of freeing glycerine from its fetid odor, freeing it from color, and depriving it as much as possible from foreign salts; finally, to obtain it in a state

of purity which should render it fit for medicinal use, and at a price which would not stand in the way of its common use. I succeeded so completely as to decide on undertaking the preparation of this substance, on a very large scale, when I communicated to the Imperial Academy of Medicine, at the same time as my processes, the most striking results of my first researches. I was in a position to furnish to the drug trade, glycerine perfectly fit for medical use, at one-tenth of the price at which it was previously sold.

Some months after, I read to the *Société de Pharmacie*, of Paris, a second Memoir, in which M. Garot and I (*see THE CHEMIST*, New Series, Vol. II. p. 59) realised, in a pharmaceutical point of view, the first applications of glycerine to medicinal purposes, on one hand, by determining, by quite new researches, the action, and especially the solvent property, of this body on a great number of medicinal substances; and on the other, by presenting numerous examples of glycerine products, classed under the specific name of *glyceroles*. We announced in the same Memoir, that these new medicaments seemed to us destined to replace, with advantage, the medicinal oils, cerates, and pommades, and to come into general use. Such is the brief history of the only attempts of which we claim priority, leaving to those who preceded us, and to those who may come after us, their rightful part in the improvements relative to the manufacture of glycerine, as well as in the elucidation of the facts which relate to the same object.

Since then, thanks to the skilful researches of MM. Demarquay, Trousseau, Denonvilliers, Debout, Luthon, Berthet, and a host of others, glycerine has, in some measure, entered into habitual use in medicine, surgery, and in the veterinary art, and the anticipations which I had formed relative to the future of this substance, in a medicinal point of view, are largely realised.

However, these trials have not been uniformly satisfactory, and it was natural to refer the cause to impurity—to the bad preparation of the glycerine employed. It was, therefore, important to determine the characters which ought or ought not to be found in that intended for medical use, and as this substance, like many others, is subject to adulteration, it was also necessary for us to seek the means of detecting the adulterations which fraud might cause it to undergo. The following are the characters to which M. Garot and I were provisionally led in this respect.

It is known that glycerine comes from various sources, and may be prepared by different processes. That which is obtained by the saponification of the pharmaceutical stearates is almost free from salts of lime, but it may retain metallic salts.

That which is obtained by the saponification of vegetable oils, retains less of volatile fatty acids, but it is deeper colored, and preserves a very disagreeable peculiar odor.

That which is extracted from the mother liquors of stearic acid manufactories is so much the more difficult to purify, as in these establishments fats of worse quality are employed. Now, as this source is that which is capable of furnishing it in the largest proportion, it is the most commonly resorted to, for obtaining this product.

An ingenious and perfectly different process is employed by Mr. Wilson, in Price's Patent Candle Manufactory (*see THE CHEMIST*, No. XXXI. p. 100). This process consists in splitting the fatty body by the action of superheated steam, and in collecting the dilute glycerine, by distillation, at a high temperature, and concentrating and decoloring it by the ordinary manner. The principal objection to this process is the dearness of the product, the price of which is nearly three times that at which glycerine is sold in France.

The following are the general characters which official glycerine, that is to say, glycerine perfectly fit for use in medicine, should possess:—

It should be without appreciable odor, even when a drop of it is placed in the hollow of the hand, and rubbed with the other hand.

Its consistence should be that of a thick syrup. It should, as a minimum, give the density of 28° of the saccharometer, at the temperature 10° C. (50° F.). To retain this density, it must be kept in well stoppered bottles, for it is somewhat hygrometric. If not absolutely colorless, it should only be of a slight umber, like oil of sweet almonds. Its taste is decidedly sweet, analogous to that of honey syrup.

It should be almost without action on tincture of litmus and syrup of violets.

1 volume of glycerine should dissolve completely in 1 volume of alcohol, acidulated with 1 per cent. of sulphuric acid, without giving rise to any deposit, even after 12 hours. The deposit which would be formed, would be proportionate to the quantity of lime contained in the glycerine.

1 volume of glycerine should dissolve completely in 2 volumes of etherised alcohol at 43° (alcohol 100 parts and ether 50 parts), without leaving any deposit, after 12 hours contact. If any deposit, granular or flocculent, is formed, it indicates the presence of salts of lime.

A syrupy residue would show the addition to glycerine of a syrupy sugar, honey or fecula, to the extent of 10 per cent. Below this proportion, glycerine retains in solution the syrups which have been added to it; but if we pour into the mixture one or two drops of sulphuric acid, a white granular deposit is immediately formed, which would not be the case with pure glycerine.

Oxalate of ammonia should not detect more lime in glycerine than it does in the water of the Seine, which is used for all domestic purposes. The sulphuric acid test is perfectly sufficient for this purpose.

Glycerine diluted with water and boiled with a piece of caustic potassa, should not undergo any alteration in color, but it speedily becomes colored when it contains 1 per cent. of glucose.

This is all we have to say at present for the information of practitioners, and to put them on their guard against the disappointments which would result from ill prepared glycerine. We should have many facts to add here, relative to the action of glycerine on organic matters, and on animal tissues and fluids, but the multiplicity and long duration of the experiments which M. Garot and I have undertaken on this subject, compel us to defer their publication for some time. This will be the subject of another communication—*Journ. de Pharm.*

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Figure 1. Map of the study area in the south-east of England. The location of the study site is indicated by a star.





